Establishing a Network Framework for TRADOC Scenarios

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14. ABSTRACT
This document identifies the framework for including network information in standard scenarios. To enable operationally relevant network analyses, the U.S. Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC) must produce scenarios with robust network representation to enable discrimination among network courses of action. This document describes the steps necessary to enrich network context in scenarios. This document and TRAC technical memorandum TRAC-F-TM-10-040, *Scenario Network Framework Documentation*, provide a systematic approach to improving the communications systems and network information in TRADOC scenarios.

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Chapter 1 – Introduction

Overview.

The U.S. Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC) is the TRADOC executive agent for the development of scenarios for use in studies and analyses.[1] As the executive agent, TRAC has the responsibility to "coordinate scenario activities" throughout TRADOC and the Army, to include other study agencies.[2] Since the 1990s, communications networking capabilities have been in the forefront of Army acquisition and analyses. The Army studied communications networking capabilities as a full and complete network, showing the benefits of enhancing information transport and management across the force. Now, in times of greater fiscal constraints, representing robust and complete communications and networking capabilities in the study of future capabilities and acquisitions is important.

Purpose.

This document describes how to establish the communications and network framework baseline for TRADOC scenarios and how to use the information in studies and analyses, briefly touching on how some information may be adapted for models and simulations (M&S). It is intended for use by TRAC study and scenario development teams.

Background.

TRADOC operational scenarios focus on the road to war; friendly and threat operational and tactical orders; weapons; munitions; sensors; and representative missions for implementation into study vignettes and/or M&S. The scenarios present overarching communications appendices to the operational orders, but may not present enough information from which to construct the communications network. Communications networks are constructed differently depending on the geographic location; task organization and modernization status/fielding of equipment; concept of operations (CONOPS); and mission(s). Additionally, the network evolves throughout all aspects of the operation as unit geographic locations, task organization, and missions change. The scenario network framework, which this document and the accompanying *Scenario Network Framework Documentation (TRAC-F-TM-10-040)* describe, provides the foundation for establishing the communications and network representations in a scenario for studies and analyses.

Importance.

This effort supports the Army's effort to establish an M&S-enabled network analysis to support semi-annual capability set decisions. This capability set analysis requires a quick turnaround to support the semi-annual Joint Capability Area (JCA) reviews (February) and the Network Investment Strategies (July) decisions.[3] Network information is ever-changing based on requirements and these decisions. Development of a network framework for an operational scenario is also time-consuming and resource-intensive. To meet the quick-turn decisions, it is vital to initiate the network framework at the same time as the scenario is developed to establish

[1] TRADOC Regulation 71-4, TRADOC Standard Scenarios for Capability Developments, 23 September 2008, p 6-7.
[2] Ibid, p. 6-7.
[3] Draft Execution Order: M&S-Enabled Network Analysis to Support Decision-Making, GEN George W. Casey Jr., Chief of Staff, U.S. Army, 30 June 2010.

"network starting conditions" and a basis from which studies and analyses may rapidly update the information. The various levels of resolution that are needed present additional complexities that consume study time. Established processes and procedures will reduce the time required to provide network representations. Future efforts should establish similar documentation for battle command systems; applications and services; network operations assets and procedures; and operational systems and equipment.

Terminology.

Below are the key terms used in this document.

- Network. The connected set of transport and communications equipment over which information flows. This network supports military operations, includes the estimated connectivity and capacity limitations, and results in communications and information transport capabilities.
- Network Information (by time frame). The technical parameters, performance, procurement quantities and planned distributions of network and communications systems across the total Army force structure. Quantities, distributions, and technical specifications vary by time frame. Significant changes to the basis of issue, accelerated programs, delayed programs, prioritization of fielding, force generation schedules, and systems' capability descriptions may be forecast by trends or preliminary acquisition decisions if not available in approved form.
- Scenario Network Framework. The application of the network information to a scenario's geographic location, task organization, concept of operation, and mission. The network framework relies on eight categories of required information and data that describe the network framework. These categories are systems information (overarching assumptions, systems book, frequency overlap, and compatibility diagrams), echelon-based assumptions, equipment lists by task organization, locations of systems, connectivity diagrams, priority-of-use lists, frequency plans, and capability descriptions. Refer to *Scenario Network Framework Documentation (TRAC-F-TM-10-040)* for more information.
- Network Data (by model). All of the data required to represent network transport and communications systems at the appropriate level of resolution for a particular TRAC model or simulation.

Objectives.

- Establish a process for collecting and updating network information by time frame.
- Establish a process for applying the network information to TRADOC scenarios, creating the network framework for the scenarios. Identify roles and responsibilities for network framework development supporting TRADOC scenarios.
- Develop a sample network framework and associated documentation for a selected TRADOC scenario. Identify the content and level of detail for creating the TRADOC Operational Scenario Network Framework Documentation in support of each TRADOC scenario. Provide adequate detail to support the development of M&S network data.

- Establish procedures for documenting changes to scenario network frameworks when applied for study use.
- Identify the TRAC M&S network data requirements and a method for network data development based on the scenario network framework.
- Recommend memoranda of agreement (MOAs) with appropriate agencies to implement the above procedures.

Process Overview.

Figure 1 shows the relationship between the network information, the scenario network framework and the network data. Each item corresponds to the remaining chapters of this report.

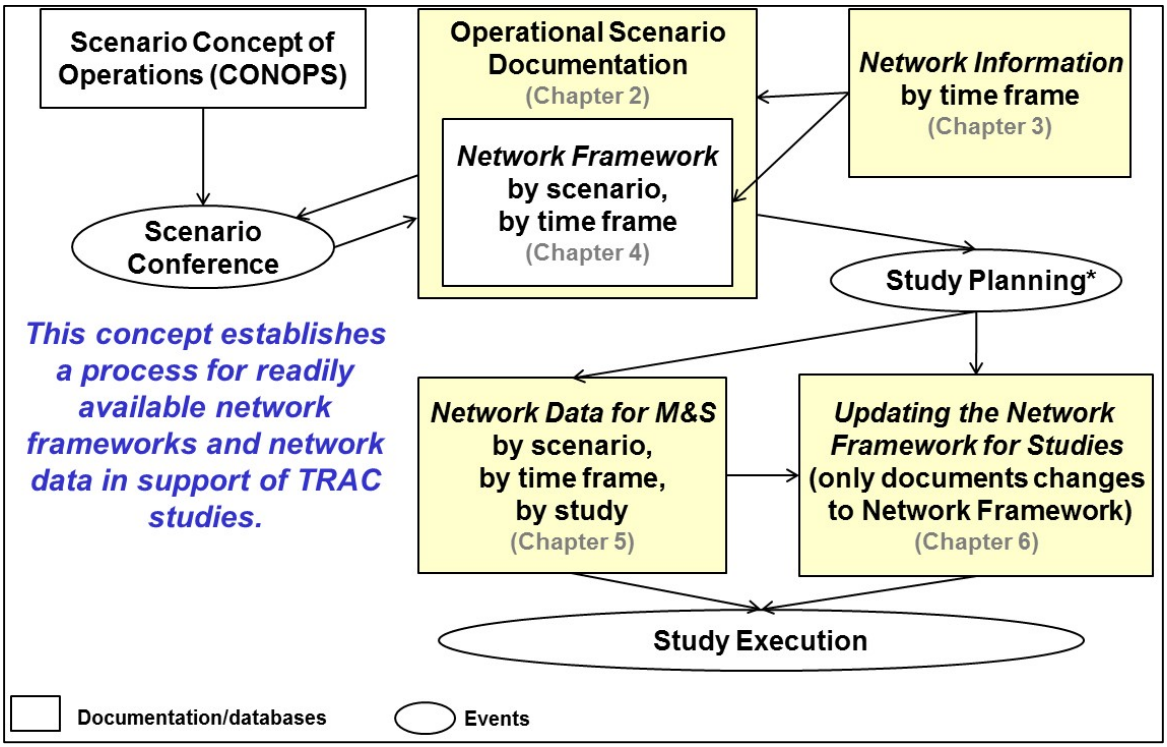

Figure 1. Concept for Establishing a Network Framework.

Content.

This document has seven chapters. The second chapter briefly describes the content of the scenario documentation and the scenario information needed to establish the network framework. Chapter 3, Network Information, describes the purpose, the type of information required, and the implementation procedures to ensure the information is current and available when needed. Chapter 4 comprises the network framework development process and recommendations for implementation. The two chapters that follow, Network Data for Models and Simulation, and Updating the Network Framework for Studies, identify how to use network information to develop data for M&S processes, and how to document updates to baseline network frameworks. The summary chapter consolidates recommendations for implementing a scenario network framework development process.

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Chapter 2 – Operational Scenario Documentation Requirements

Purpose.

This chapter describes the operational scenario information needed to develop the scenario network framework. This information should be incorporated into the standard scenario documentation.

Scenario Documentation Overview.

Certain information is required, per TRADOC Regulation 71-4, for the operational scenario documentation. This documentation normally contains road to war; friendly and threat operational and tactical orders; weapons; munitions; sensors; and representative missions. Two scenario documents (Multi-level Scenario (MLS) 1.0 (7th Division) and MLS 2.0 (IX Corps) were used to identify the operational scenario documentation needed to establish the network framework.[4]

Operational Scenario Documentation Requirements.

For TRAC to perform network analyses or to portray realistic network capabilities for studies and analyses, the network framework must establish a credible foundation describing the network for a particular scenario. Certain information regarding the geographic location, task organization, CONOPS, and mission is necessary. The scenario documentation elements needed for the network framework development are described below. For examples of these elements and their importance to the network framework, see appendix A.

- The theater and support force construct and their distribution throughout the task organization down to company and team level.
- The telecommunications infrastructure within the theater of operations.
- Locations of all theater-related headquarters and theater support force structures, including U.S. Combatant Command (COCOM), coalition, and multinational supporting headquarters (HQ).
- Locations of host nation and transit nation capital and major cities, and critical facilities throughout the area of operations (AO).
- Locations for all key objectives and cities in the area of responsibility (AOR).
- Deployment schedule for theater units.

Implementation.

Two methods are useful in documenting these operational scenario requirements. The first method incorporates the information in the concept stage of scenario development. An alternative is to "backward plan" and create the information in the development of the detailed scenario. The first method is preferred to ensure that a complete, holistic, and consistent scenario

[4] Note: The *network framework* example developed for this effort *(TRAC-F-TM-10-040)* derives from the MLS documentation as implemented for the Network Transport Capabilities Based Assessment (NT CBA). Variations in the 1st and the 4th Divisions exist between the MLS operational scenario documents and the version used for the NT CBA. The MLS version used for the NT CBA was initially developed in 2006 with a detailed theater support structure for use by the project manager (PM) for the Warfighter Information Network - Tactical (WIN-T) program.

concept is developed. The first method also provides greater flexibility in the resourcing of the network framework development.

- Preferred method (during CONOPS development). In the initial scenario CONOPS development by TRAC, abbreviated mission analysis should begin to outline the theater force structure construct and locations as well as locations of host nation cities and critical infrastructure, resulting in an acceptable scenario construct. The network planning team should initiate the telecommunications infrastructure laydown in preparation for the detailed scenario development that occurs in the scenario conference.[5] With all of the operational scenario requirements documented, the network framework development may begin.
- Alternate method (during the detailed scenario development process). This approach initiates the detailed development of the scenario at the scenario conference attended by TRADOC centers, schools, and labs.[6] This conference is where the development of the network framework must begin. If the baseline operational scenario information described in this chapter is not yet developed, TRAC must create the information before the development of the network framework.

Scenario Documentation Requirements Summary.

The operational scenario documentation requirements, in addition to existing scenario documentation content, provide the foundation of the network framework development. Without this information, the network infrastructure (for example, reach-back, satellite access, network service centers, host/hostile nation interoperability, and interference) cannot properly be established and documented. The next chapter describes the network information, which is also critical to the network framework development process. Together, the operational scenario requirements and the network information provide the necessary data to develop the network framework for a given scenario.

[5] TRADOC Regulation 71-4, para 3-1.b., p 13.
[6] Ibid.

Chapter 3 – Network Information

Purpose.

Network information products comprise the technical parameters, performance, procurement quantities, and planned distributions of network and communications systems across the total Army force structure. This chapter describes the baseline network information that must be readily available before developing a network framework for a particular scenario. This network information continually changes and, as a result, must be updated regularly. This chapter also describes general procedures for attaining and updating the network information.

Network Information Products.

Appendix B presents each of the seven network information products listed below, describes their relevance to the scenario and to the network framework, and discusses the perishability of information, the authoritative and credible source(s), the recommended update procedures, and the recommended storage.

- Force Structure (by time frame). The Army Structure (ARSTRUC) Memorandum, which was produced from the Total Army Analysis (TAA) and Program Objective Memorandum (POM) processes, describes the overarching structure of the Army, which is apportioned among four components (COMPOs): the Active Army (COMPO-1), the Army National Guard (ARNG) (COMPO-2), the U.S. Army Reserve (USAR) (COMPO-3), and unresourced unit equivalents (COMPO-4).[7] Army force structure is needed to understand the quantities of Army units, by type, by COMPO, and by time frame. Of particular interest are the expeditionary signal battalions (ESBs) available for signal support.
- Army Force Generation (ARFORGEN) Schedule. The ARFORGEN schedule provides information on the availability and the modernization of the Army force structure. Of particular interest is the availability of the ESBs for deployment. Previous scenario network framework experience shows that, for a major combat operation (MCO), there are often more ESBs required to support the operation than there are ESBs available through ARFORGEN. Therefore, the additional ESBs provided outside of their ARFORGEN schedule may have degraded capabilities when providing signal support to the force. The ARFORGEN information also provides a gauge for the quantity and the COMPO status of the force structure in the scenario. Supplying a mix of COMPO types in the scenario force structure is the best way to truly analyze a plausible force deployment. Often, the COMPO-2 and -3 units have different network and communications equipment than the COMPO-1 Active Army. With these mixes of capabilities, ESB support may vary and communications interoperability between units may be affected.
- Network Equipment List. This list is critical to the development of the scenario network framework. This list should encompass all communications and network transport equipment in the force today and the planned and programmed systems that have entered into the military acquisition process. It must include program names, line item numbers, and availability dates and identify replacement systems/equipment for those items

[7] Army Regulation 71-11, Total Army Analysis, 29 December 1995, p 1.

departing Army inventory. This list serves a purpose similar to the weapons, munitions, and sensors list (WMSL) produced as part of the scenario documentation.

- Equipment Descriptions. Equipment descriptions present the detailed characteristics of each current and future network and communications system/equipment on the Network Equipment List. This enables a clear understanding of the transport capabilities and is used in the framework development process as well as in supporting M&S. Specific characteristic categories are physical descriptions, component descriptions, technical specifications, interoperability descriptions, classification, network operations capabilities, sustainment requirements, and operational considerations. The information needed to represent a network must be credible and accurate. It must also be thorough, describing all aspects of a communications system so that the scenario may represent it accurately.

- Tables of Organization and Equipment (TOEs). TOEs prescribe the "required structure and mission essential wartime manpower and equipment requirements" for various unit types.[8] These TOEs (or the variations – modified TOEs (MTOEs) and objective TOEs (OTOEs)) provide a baseline unit structure and associated equipment for units. Due to rapid changes in network and communications purchases and procurements, these databases are often 1) not the most recent structure of the unit, 2) not always representative of a future time frame, and 3) difficult for translating various pieces of equipment into systems (because the components are listed separately). A tool, such as TRAC's proposed Network Architecture Integration Service (NAIS) concept linked to the Capabilities Assessment Development and Integration Environment (CADIE) and the Architecture Based Capabilities Assessment Software (ABCAS), will alleviate issues related to TOE data. The NAIS concept intends to import CADIE/ABCAS TOEs and screen the line item numbers (LINs) to meet TRAC M&S data requirements, resulting in the appropriate resolution of systems for each M&S. Some units update structure and equipment through documentation. Brigade combat teams (BCTs) are documented in the Fort Knox Supplemental Manual 71-8 Armor/Cavalry Reference Data Brigade Combat Teams prepared by TRADOC in May 2010. Documents like this are likely more up to date than the BCT TOE files controlled by U.S. Army Force Management Support Agency (USAFMSA) and accessed by CADIE/ABCAS.

- Procurement Schedules. Procurement schedules show the allocation of future network and communications equipment across the force structure (by time frame). The schedules describe the current plan for purchasing and fielding the future equipment – by calendar or fiscal year – for distribution across the force structure. This information is needed for each network and communications system/equipment in the acquisition process.

- Basis of Issue Plans (BOIPs). These plans describe in quantitative terms the doctrinal groupings of personnel and equipment for Army organizations. "A BOIP provides personnel and equipment changes required to introduce a new or modified item into Army organizations."[9] This information is particularly important for the equipment not yet fielded or documented in a TOE. This information will change as procurements, procurement schedules, and force structures change. Therefore, the time frame the BOIP

[8] How the Army Runs, Senior Leader Reference Handbook, 2009-2010, p 54-55.
[9] How the Army Runs, p 55-56.

represents, its correlation to the procurement schedule, and specific force structure are critical.

Implementation.

The network information requires regular updates and an "as of" date due to the frequency of changes to the information. This information should be updated semi-annually after the JCA review in February and the Network Investment Strategy decision in July. This network information is critical to the development of the scenario network framework and is often difficult to track down, given the multiple organizations involved in creating the information. Similarly, responsibilities for the update and maintenance may vary. The force structure and ARFORGEN products are required for scenario development, network development, and most studies and analyses. The remaining products focus on the network data, but could be expanded to encompass all weapon systems and munitions to support TRAC analyses.

The network information comes from various sources documented in appendix B. Because of data perishability and personnel turnover, TRAC should develop MOAs with each of these organizations to specifically share the information needed. The table below shows recommended sources for each type of network information.

Table 1. Potential Network Information Sources.

Information	Source(s)	Update Schedule
Force Structure (ARSTRUC Memo)	Army Knowledge Online	Annually (January)
ARFORGEN (synchronization tool)	Forces Command	Annually (January)
Network Equipment List	TRADOC Capability Managers (TCMs)	Semi-Annually
Equipment Descriptions	Program Executive Officers (PEOs), Project Managers (PMs), TCMs	Semi-Annually
TOEs	CADIE/ABCAS in conjunction with (ICW) NAIS	Start of scenario
Procurement Schedules	Army G-8	Semi-Annually
BOIPs	TCMs	Semi-Annually

Network Information Summary.

MOAs or memoranda of understanding (MOUs) are needed with the network information providers to ensure the data are available when needed. Appendix B identifies the various organizational sources, along with examples, relevance to the scenario and to the network framework, information perishability, recommended update procedures, and recommended storage. Development of the scenario network framework is impossible without readily available, up-to-date network information.

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Chapter 4 – Scenario Network Framework

Purpose.

A network framework is the result of applying the network information to a scenario. The network framework documentation should be incorporated into the standard scenario documentation. This chapter presents organizations involved in the framework development, the lessons learned in the first scenario network framework development, the resulting recommended process for developing the framework, what the documentation entails, how the information is used, and recommendations on implementing the framework development process for TRADOC scenarios supporting studies and analyses.

Background.

TRAC develops Army and joint scenarios at various echelons. Historically, communications annexes to the operational orders are developed for the scenario, but detailed communications and network planning is not performed. This sometimes results in operational plans that may be too dependent on satellite and non-line-of-sight communications than if the communications and network planning had been tightly integrated with the operational planning. This was found to be the case in the first network framework development using the MLS in support of the NT CBA. Therefore, it is critical to future network frameworks that communications annexes be developed ICW the CONOPS for each scenario.

Framework Initiation.

For the framework development to begin, the information described in the previous two chapters must be available and up to date. In addition, three elements set the foundation for beginning the scenario network framework development: organizational support, scenario development integration, and tool integration. These three elements are discussed next.

- Organizational Support. Before creating a new network framework for a scenario, TRAC should establish MOAs with the following organizations, whose roles are detailed in the Framework Implementation section of this chapter. These TRADOC organizations focus on Warfighters' implementation of network and communications systems. They are the operational experts needed to implement the network and communications systems within TRADOC scenarios.
    - U.S. Army Signal Center of Excellence (SIGCOE). Within TRADOC, the SIGCOE represents the Warfighter for doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) domains. The primary SIGCOE directorate needed to represent the operational signal concerns during scenario and network framework development is the Capability Development and Integration Directorate (CDID). Other elements in the SIGCOE that may provide support include the Directorate of Training (DOT), Leader College of Information Technology (LCIT), Ordnance Electronic Maintenance Training Department (OEMTD), and the SIGCOE's 15th Regimental Signal Brigade.
    - Other Operational Experts. The 9th Signal Command (Theater) is leading efforts for development and implementation of the Network Service Center (NSC) concept and will have resident experts. The 7th Signal Command (Theater) is another potential source for operational signal experience. Other communications and network experts

with recent operational experience may be in the Army Capabilities Integration Center's (ARCIC's) LandWarNet Division, Headquarters, Department of the Army (HQDA) G3/5/7 LandWarNet, and HQDA G-6.

- Scenario Development Integration. For an effective and realistic scenario network framework, integration must occur in the scenario development process. Communications networks are constructed differently depending on geographic location, task organization and modernization status/fielding of equipment, CONOPS, and mission. Additionally, the network evolves throughout all aspects of the operation as the geographic location, task organization, and missions change over time. Therefore, the scenario network framework must occur simultaneously and in support of the scenario development process. If executed properly, communications and network "starting conditions" for M&S result.
- Tool Integration. Since the 1990s, when network analyses were in their infancy, many organizations have developed tools that support the complex descriptions of networks for scenarios. Continued research and upgrades to incorporate advancements will provide greater ease and speed in network development for studies and M&S. A suite of tools is needed to fully implement and support the network framework development. Tool functions needed are task organization and initial equipment set generation (TRAC's NAIS concept fulfills this function); connectivity and information flow assessment; and capacity assessment.

A variety of tools can support connectivity and information flow assessment. The NAIS concept provides connectivity assessments. A developing suite of MITRE tools also provides connectivity assessments, information flow assessments and thread/traffic assessments.[10] Other stand-alone connectivity and information flow assessment tools for potential use in network framework development include:

- Joint Network Management System (JNMS) is a COCOM joint communications planning and management system. It gives communications planners the ability to conduct high-level planning; detailed planning; monitoring; and spectrum planning and management of joint networks.
- Systems Planning Engineering and Evaluation Device (SPEED) is a U.S. Marine Corps government off-the-shelf (GOTS) software program for communications planning and analysis. SPEED provides line-of-sight (LOS) radio coverage analysis, satellite planner, Enhanced Position Location Reporting System (EPLRS) planner, and much more.
- NetMaps provides WIN-T planning functions. NetMaps determines connectivity and capacity for WIN-T LOS components (currently only increment (INC) 2) in an operational environment.

Assessing capacity requirements in the network planning and network framework development process is much more difficult. Spreadsheet tools developed to support the High Capacity Communications Capability (HC3) Analysis of Alternatives (AoA) and the NT CBA are recommended for network framework development over detailed analytic tools such as the

[10] The suite of MITRE tools includes the Transport Design Reference Model (TDRM), the Joint Network Analysis Tool (JNAT), and the Mission Thread Analysis Tool Suite (MTATS).

Optimized Network Evaluation Tool (OPNET), Net Warfare Simulation (NETWARS) and the Joint Network Analysis Tool (JNAT). Spreadsheet tools and short descriptions are below.

- Operational Capacity Tool, developed by MITRE in support of the HC3 AoA, identifies satellite terminal capacity in megabits per second (Mbps) that a unit should realistically expect to achieve on the battlefield. A description is in TRAC-TR-08-009 HC3 At-the-Halt (ATH) Wideband Satellite Communications (SATCOM) Terminal Assessment Final Report, appendix E, annex I.
- WIN-T INC 2 High-band Networking Waveform (HNW) Burst Rate Calculator is a spreadsheet, approved by TCM Network and Services (TCM NS), and used in conjunction with NetMaps to calculate the number of links per node at a point in time. It provides HNW capacity estimates for WIN-T INC 2. The NT CBA assumed INC 3 to be three times the capacity than the INC 2 capacity for the same number of links.[11] This assumption may require adjustment as INC 2 and INC 3 mature. The number of links varies by time, terrain, mission, and task organization in the operational environment. Appendix D provides the spreadsheet format.
- BCT Radio Capacity Estimate Spreadsheet, developed by MITRE, supported the NT CBA with estimates of radio capacities for BCTs. This tool is described in the companion report, Scenario Network Framework Documentation (TRAC-F-TM-10-040).
- On-the-move (OTM) Satellite Access Estimates tool enables the analysis of channel capacity limits in the operational environment. Appendix D briefly describes a rough estimate calculator for WIN-T OTM satellite accessibility across the force.

Framework Lessons Learned.

The first scenario network framework was developed during the NT CBA from October 2008 through July 2009. The extensive time was due to the difficulty in finding the network information and the time to complete the missing scenario information. Therefore, the next two chapters of this document address those areas in detail to overcome the time it takes for network framework development. The importance of having that information ready and available cannot be stressed enough. Other lessons learned in the course of the first network framework development are provided below:

- Encompassing all tiers (terrestrial, aerial, satellite) and all communications and network transport components that support the Warfighter provides a more accurate representation of the network. Network analyses should study a holistic network. The network framework represents the holistic network as the established baseline.
- Developing the network framework in a study often overshadows many critical technical and operational network insights. By developing the framework as part of the scenario development, a focus may be placed on documenting those technical and operational network insights as the “network starting conditions” for the scenario.
- The network framework must be developed from top-down to appropriately implement often-limited network resource allocations. This is contrary to real-world planning that

[11] TCM NS approved this estimate.

occurs in parallel at all echelons, with lower echelons sending resource requests up the chain.

- SATCOM is in a continual state of short supply, particularly as the federal government sells frequencies reserved for military use and as the aging fleets of satellites die. Because SATCOM is often a preferred method of communication because of the seemingly constant connection capability (beyond line of sight (BLOS) capability), theater through company echelons (with some access to the Soldier) are becoming highly dependent on SATCOM. These limited resources must be analyzed and allocated across the theater of operations, which may greatly impact brigade-and-below access.
- Experts exist by system/equipment or by a specified function and are often limited in availability. They often support many tasks; therefore, their support to scenario network framework development must be coordinated early. MOAs with their organizations for support to the scenario network framework development are critical to accessing the expertise.
- Develop the scenario network framework based on fielding plans and program decisions. Publicize the "as of" date to preclude redeveloping the network to continual program changes and adjustments.
- Units are equipped with different mixes of current and future program of record (POR) or developmental transport systems because of varying fielding plans; no plans exist for fielding a homogeneous network transport capability across the force. This supports the need for establishing the framework and analyzing it to establish the scenario network capabilities across the force.
- Expand the scenario network framework documentation to encompass all of the critical data related to the future network. Information needed includes:
    - List of battle command systems, applications, and services, along with their capacity usage and data requirements.
    - Database and services locations, replication procedures, and information flow.
    - Relevant information quality criteria[12] for the information flowing across the network; these quality criteria potentially change for each mission, enemy, terrain and weather, troops and support available, time available, and civil considerations (METT-TC) variation.
- For M&S data, performing a detailed review of information exchange requirement (IER)-based traffic for network modeling efforts is required. The currently available database does not portray IERs for all tasks conducted by all unit/echelon types from Soldier to joint task force (JTF)/theater.
- IER-based traffic is built for organizations and specific missions, not necessarily encompassing the full task organization and mission in the larger scenario context. This traffic limitation greatly reduces the amount of traffic represented.

[12] Field Manual (FM) 6-0, Mission Command: Command and Control of Army Forces, August 2003, page B-17.

Framework Development Principles.

Four key principles drive the scenario network framework development: top-down build, development of assumptions, nodal approach, and analysis of the framework. These should be followed throughout the entire development process. Without them, the scenario network framework will not appropriately represent network capabilities for the TRADOC scenario and specific time frame.

Top-down Build. The first network framework development, during the NT CBA, struggled for a couple of months to determine the best method. The real-world complexities of parallel-planning at each echelon, of user requests going from bottom up, and the combination of organic and force pooled equipment comprising the network presented significant issues for the limited set of experts available. Finally, the NT CBA's top-down approach (theater to Soldier) was more than adequate in creating a network framework for a scenario.

Development of Assumptions. During the NT CBA, the network development team attempted to establish the underlying assumptions regarding the scenario network framework *before* building the network. This was unsuccessful. Assumptions must be captured at every stage in the framework development process. Many types of assumptions are related to the network framework:

- Overarching assumptions. These are statements related to how the network framework was developed, taken as true in the absence of facts, often to accommodate a limitation. Identifying framework limitations first often facilitates the development of the framework assumptions. An example of a limitation and its associated assumption is shown below.
    - Limitation: The network is an ever-changing system of systems. This documentation is based on February 2009 information updated with December 2009 information.
    - Assumption: The network framework is representative of the future 2017-network transport and communications capabilities.
- Echelon-based network assumptions. These are statements related to communications and network capabilities for a particular echelon that are taken as true in the absence of facts. Develop and document strategic assumptions down through the lowest echelon of focus for the scenario.
    - An example of a strategic assumption: Department of Defense (DOD) spectrum availability remains constant through 2017.
    - An example of a division-based network assumption: Divisions units deploy with their organic hub nodes.

"Nodal" Approach. The greater the detail in locations of the communications and network transport systems/equipment, the easier it is to apply the scenario network framework to all types of studies, analyses, and M&S. The detail relies on a "nodal" approach for establishing the scenario network framework. A "node," for the purposes of this report, is a point where information flows over communications or network transport systems/equipment originates, relays, or terminates. For example, a brigade headquarters is not a single node. The headquarters is operationally separated into distinct command posts in different locations, to include a mobile command group (MCG). Each command post and the MCG have different quantities and/or types of communications and network transport systems/equipment. Therefore, it may be

important to differentiate these locations within the network framework. Depending on the level of detail or echelon focus of the scenario, the network framework could potentially even separate each soldier or vehicle into a separate node. A decision on the nodal-level of detail is required before the scenario conference.[13]

Analysis of the Framework. The final principle that accompanies the scenario network framework development is the analysis of the framework. Without this analysis, the network capabilities for the scenario, the network starting conditions, and the operational effect of the network on the force cannot adequately be determined.

- Operational Network Capabilities. This involves assessing connectivity, information flows, and capacity limitations to determine the operational network capabilities. For example, assessing satellite usage places limits on communications capabilities from theater down to the company commander and sometimes beyond. Merely modeling or representing a battalion's network connectivity with its organic assets over represents the capabilities of the force. See the MLS OTM limitations in figure 2 as an example of why this analysis is important. Note: To understand the limitations at lower echelons for OTM SATCOM, lay out the framework from theater down, or the network capabilities will represent more capability than the force will actually have.
- Electromagnetic Interference (EMI). Friendly force and host nation EMI may affect the operations and capabilities of the network. This assessment may be important to upcoming studies and analyses and should be addressed, at least through network assumptions. This assessment requires an understanding of friendly force and host nation spectrum usage.

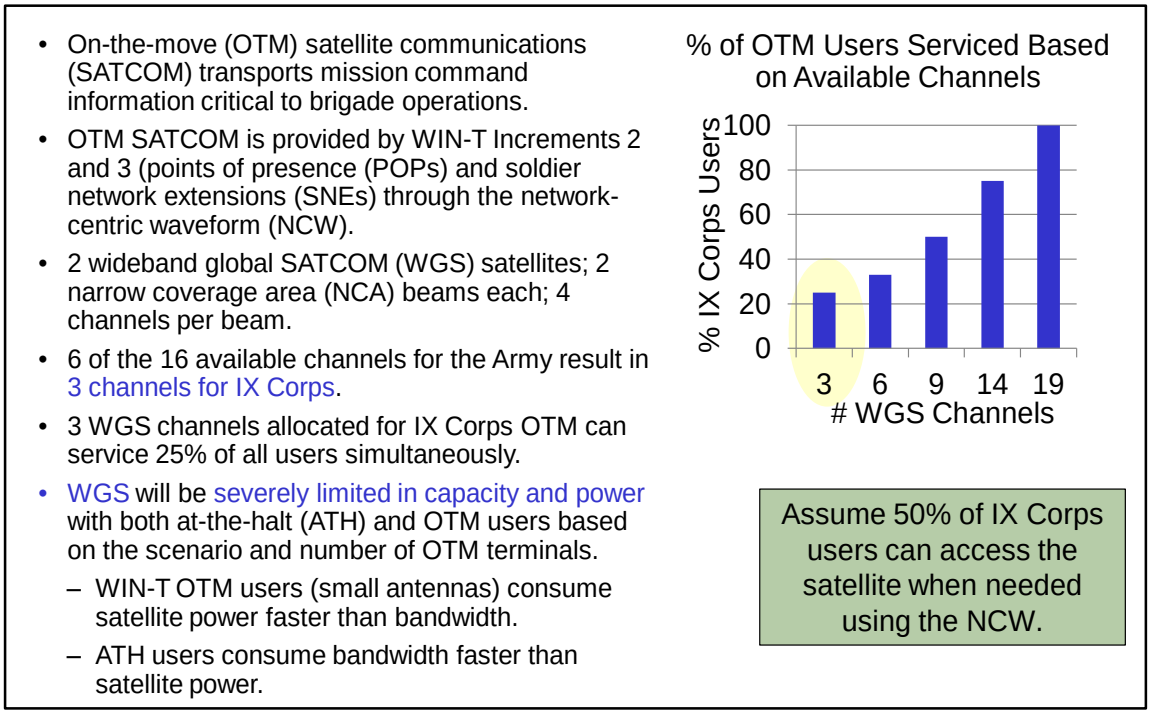

Figure 2. MLS Brigade OTM SATCOM Framework.

[13] TRADOC Regulation 71-4, para 3-1.b., p 13.

- Threats. The analysis must take into account the threats to the network. This assessment requires input from the TRADOC Intelligence Support Activity (TRISA) in the scenario development process. Similarly, if possible, the study team should develop a network structure for the threat that represents the various levels of communications the threat forces use. This provides a foundation for future electronic warfare analyses such as the upcoming Integrated Electronic Warfare System (IEWS) family of AoAs.

Framework Development Process.

Communications and network structures change during a military operation to adjust to the changing needs of the force. For a scenario network framework, accounting for all of the changes throughout the entire operation is impossible. When the scenario network framework is linked to scenario development, however, the scope of the changes is greatly minimized and focused on the particular time period and missions within the scenario description. As a result, four key steps, summarized below, must be performed to develop the network framework for a particular scenario. Appendix D breaks these steps down into a checklist for describing the network framework content within each step.

The first step is describing the strategic infrastructure of the theater of operation. This describes the availability of fiber-optic and landline cable and wiring coming into the theater of operation and describes, by establishing overarching assumptions, how the theater forces will use the available communications infrastructure. This step also involves identifying the standard tactical entry points (STEPs) and teleport locations used for reach-back communications. Assumptions for National Command Authority (NCA) communications, interagency and intergovernmental communications interoperability are addressed here.

The second step in the process describes the initial point in the scenario when all of the corps-and-above headquarters and support elements are established in theater. At this point, the corps-and-above communications and network assets may be laid out to establish the corps-and-above network framework. Here the organic assets of the corps-and-above elements are established and the number of ESBs are determined and distributed to support the corps-and-above framework. This corps-and-above framework sets the stage for the development of division-and-below development.

The division-and-below development is the third step in the network framework process. This establishes the "network starting conditions" for the particular period and missions described in the scenario. All organic assets for division-and-below echelons are identified and assessed. Depending on the scenario, the lowest echelon may vary from brigade to Soldier. Based on the assessment, this is where division-pooled assets, such as unmanned aircraft systems (UASs), can be distributed to appropriately support the missions the scenario describes. The most important and time-consuming part of this step is the identification, allocation, and analysis of the satellite resources for the theater of operation. This third step in the network framework process incorporates SATCOM network laydowns from each of these first three steps. Figure 2 provides an example of part of the results of this satellite laydown and assessment.

The fourth step is an evaluation and assessment of all points in the scenario operation (mission) where key changes in network support will occur. This includes adjustments in relay support (whether terrestrial or aerial). Considerable detail and alternate courses of action must be considered in describing the specifics of the conditions in the operation that require a change in network support as well as details to describe the specific network changes occurring for the

communications systems or processes. This step should incorporate other analytic evaluations and assessments of friendly force and host nation EMI as well as threat assessments to the network, as described previously in the Framework Development Principles.

Framework Documentation.

Categories of required information are data sets that comprise the scenario network framework. These categories are systems information (overarching assumptions, systems book, frequency overlap, and compatibility diagrams), echelon-based assumptions, equipment lists by task organization, locations of systems, connectivity diagrams, priority-of-use lists, frequency plans, and capability descriptions. The *Scenario Network Framework Documentation (TRAC-F-TM-10-040)* documents these categories and a sample network framework for MLS in support of the NT CBA.

Framework Implementation.

This section describes two aspects of framework implementation: integrating the network framework with scenario development, and resourcing the implementation effort.

Integrate the Network Framework with Scenario Development. TRAC typically conducts abbreviated steps of the military decision making process (MDMP) when building the scenarios. The abbreviated MDMP involves initial CONOPS development, a scenario conference to finalize the course of action (COA), and documentation completion. These three steps are described below. Study or scenario teams may also refer to figure 3 and use the checklist in appendix C as a guide for developing signal/communications products.

- Initial CONOPS Development. TRAC, in coordination with TRISA, develops an initial CONOPS based on the scenario production plan.[14] This information is distributed to TRADOC organizations in preparation for the scenario conference. At this point, scenario network framework development may begin. When preparing to attend a scenario conference, the team must conduct a thorough mission analysis with all available information. TRAC provides the region, time frame, mission, task organization, and CONOPS statement. Network and communications planners will need at least two weeks to prepare information required in the scenario conference. Although all steps of mission analysis are important, the most critical for this process is reviewing the communications and network assets available and developing facts and assumptions.
- Scenario Conference. The conference replicates an Army staff that executes an abbreviated MDMP. The staff members come from TRADOC proponents, schools, centers, and battle labs representing all warfighting functions. While participating in the MDMP with other staff members, the network and communications planners must:
  - Refine products and brief them to other participants.
  - Document command post and critical communications node locations as the friendly COA is developed.
  - Develop additional products listed in appendix C.

[14] Ibid.

- Evaluate the COA (using LOS tools if available) and provide recommendations on COA feasibility from a communications perspective.
- Evaluate and document threat effects on the communications plan.
- Begin sub-net and connectivity development to document which units or communications nodes are connected on which dedicated "nets" to other units or nodes.
- Begin development of the signal annex to the operations order (OPORD).

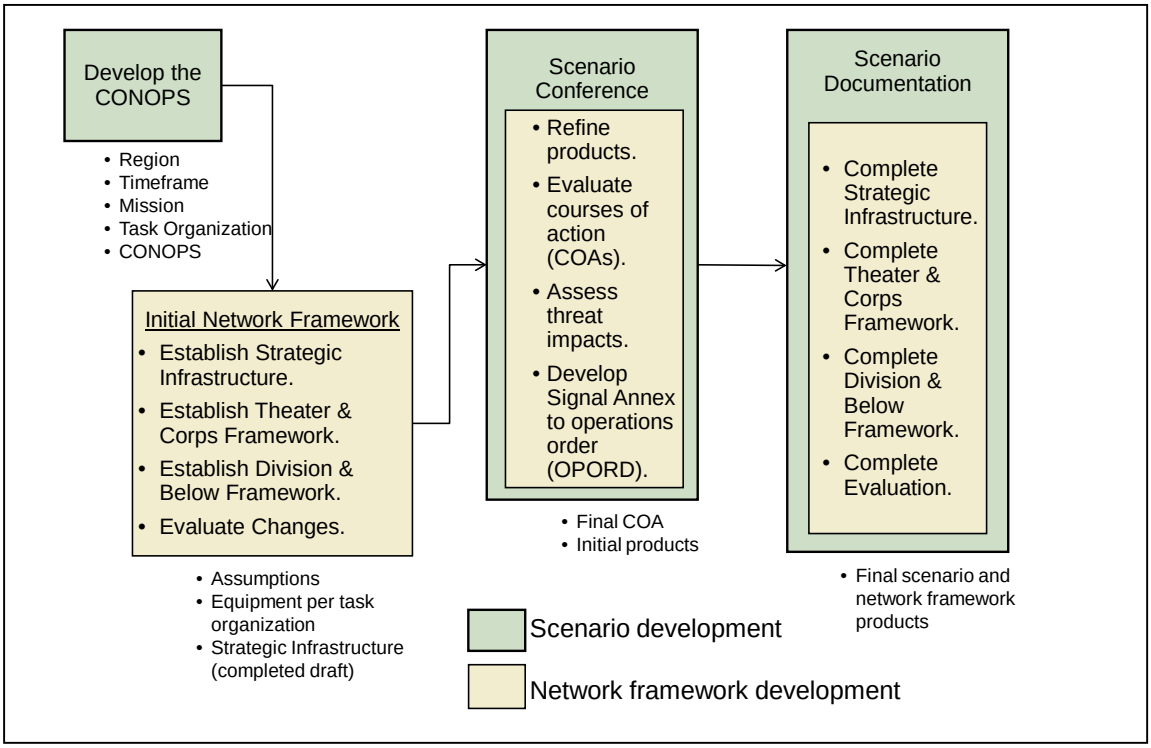

Figure 3. Network Framework/Scenario Development Integration.

- Documentation Completion. Based on the results of the conference, the network development team continues to develop and refine the products. The team will need four to twelve weeks to complete the products which are critical for the scenario. The TRAC scenario documentation lead will serve as the integrator for compilation and submission into the scenario approval process. If the products are not completed during the original scenario development, then each time the scenario is used, users must create their own understanding of the necessary network development, resulting in several different versions of a network for the same scenario.

Resourcing the Implementation Effort. The network framework requires a team of network and communications planners to create the multiple products recommended to support studies, analyses, and M&S. The construct of this team may vary depending on availability of the experts. A TRAC lead is required to ensure the complexities and scope of the required information are produced to meet analytic needs. The operational signal experts are found within

the SIGCOE. The incorporation of personnel from the following SIGCOE organizations is recommended. However, the signal experts are in great demand across the Army. Therefore, a representative from each organization is not always possible to obtain and will require an MOA. The examples below describe the type of support required:

- CDID Concepts, Requirements and Doctrine Division (CRDD). One representative from the CDID CRDD's Concepts and Doctrine Branch (CDB) or Materiel Requirements Branch (MRB) should be the lead representative from the SIGCOE to guide the implementation of the operational signal network. This person, in coordination with the TRAC Scenario Network Framework lead, 1) tracks the tasks and product development, 2) ensures timelines are met, 3) involves appropriate signal experts for quality products, and 4) leads the review of the products by all SIGCOE branch and directorate heads.
- TCM Tactical Radio (TR), CDID. TCM TR representatives must understand and appropriately represent current and future radio capabilities. As the scenario echelon focus approaches company to Soldier, more TCM TR representatives will be necessary to develop the network framework for those echelons.
- TCM Global Network Enterprise (GNE), CDID. TCM GNE representatives must understand and appropriately represent the array of satellite terminals and network operations capabilities.
- TCM NS, CDID. TCM NS representatives focus on the increments of the WIN-T and other network transport components.
- Experimentation Division/Battle Lab, CDID. The Battle Lab leads specific network analysis efforts and oversees the Network Service Center for Training (NSC-T) for the SIGCOE. Participation from the Experimentation Division is optional depending on the need for NSC information and modeling/data support.
- Fort Gordon. Also on Fort Gordon, within or outside the SIGCOE, there are network planners and personnel with recent operational experience who may be required to provide critical expertise to the scenario network development.

Other technical experts to address specific operational or technical issues in the scenario network framework development can be found throughout the Army and joint community, as well as at federally funded research and development centers (FFRDCs) and contractors. Example organizations: HQDA G3/5/7; HQDA Chief Information Officer (CIO)/G6; ARCIC; Space and Missile Defense Command (SMDC); TRADOC Centers of Excellence (COEs); Research and Development Centers (RDECs), like the Communications-Electronics Research, Development, and Engineering Center (CERDEC); and MITRE.

Scenario Network Framework Summary.

MOAs and/or MOUs are needed with the SIGCOE and potentially other organizations to ensure operational implementation of network capabilities for the scenario under development. If this process is followed and the network information is kept up to date, the network framework should be achievable.

Chapter 5 – Network Data for Models and Simulations

Purpose.

This chapter describes the vision and future concept for the scenario network framework and how they establish the foundation for future automation supporting studies and M&S.

Network Framework Vision.

Ultimately, the vision for the scenario network framework is to have a user-friendly process by which baseline network information and scenario network framework data are available for use in M&S through preprocessing and outputting model-ready data. Work still needs to be done in this area. This chapter describes the concept, some of the data requirements for key M&S, and what is needed to further develop the M&S concept.

M&S Concept.

Conceptually, once a task-organized force is established for a scenario, the network information and network framework data are used and preprocessed to feed data into the combat and operational simulations. Figure 4 depicts a general concept of:

- How NAIS supports scenario and scenario network framework development as the information matures and the framework is built.
- How the scenario network framework development is assisted through multiple tools like JNMS, SPEED, and spreadsheet tools referenced in chapter 4.
- How the scenario network framework may be evaluated and assessed before running combat simulations supporting studies and analyses.
- How network information and scenario network framework data may be preprocessed to feed the combat and operational simulations for studies and analyses.
- How the network information may be preprocessed into a systems book for scenario and study documentation.

Figure 4 depicts the scenario and network framework processes across the top of the chart (see figure 3 in chapter 4 for the complete scenario and network framework process). The interaction with supporting tools and the flow of information into preprocessors are depicted across the bottom of the chart.

As scenario developers establish initial starting locations and identify unit objectives in the CONOPS development, they can initiate the network framework development through the use of CADIE, ABCAS, and NAIS, pulling in the communications and network equipment by TOE into the task organization. This establishes the company-and-above organic equipment for the specified scenario. The remaining network framework equipment may then be added to each appropriate TOE (see blue text in figure 4). This comprises new equipment not yet developed or procured, the distribution of ESB-provided equipment, the locations of terrestrial and aerial relays, gateways, and commercial off-the-shelf communications (COTS) and network equipment not resident in the TOEs.

As discussed in chapter 4, many spreadsheet and connectivity tools may be used to evaluate the developing scenario network framework's connectivity and resource usage. In framework development, a connectivity diagram is created that indicates where and how units have

connectivity across the task organization, based on the terrain and mission. This assists with the placement of relays, gateways, and equipment augmentation. Some of the network analysis tools, e.g., NAIS and MITRE's TDRM, support these connectivity assessments in the framework development and for the studies and analyses. An information flow assessment is needed to plan the network for the scenario. As studies evolve, eventually scenarios need to develop frequency plans to evaluate the communications network at a very high fidelity. There is also the need to list which communications equipment should be used first if more than one method of communication exists between units. Each area can benefit from automation and tool support.

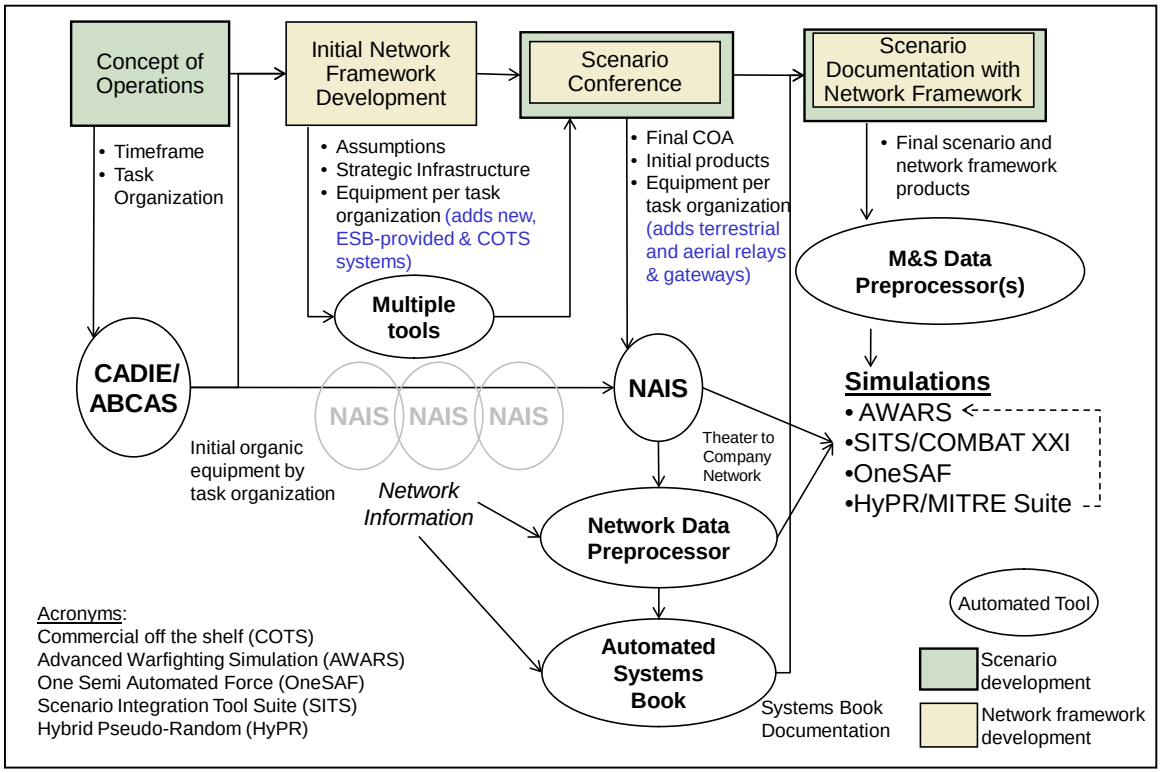

Figure 4. M&S Concept.

TRAC designed the required information, described in Chapter 4 and presented in the *Scenario Network Framework Documentation (TRAC-F-TM-10-040).*, with an understanding of the type of information needed for TRAC M&S. Therefore, the scenario network framework documented in the required information formats provides a basis for informing simulations. The technical data in the network information could be established in similar model-ready formats for preprocessing.

The systems book, also described in *TRAC-F-TM-10-040* may be developed by preprocessing the equipment description elements of the network information. This preprocessing requires specified formats in databases in which to store the equipment descriptions.

M&S Data Requirements.

The communications-specific network data used as input by models vary because of the models' fidelity. Two Army force-on-force models, the Advanced Warfighting Simulation (AWARS) and Combined Arms Analysis Tool for the 21st Century (COMBAT XXI), are always evolving, and the data requirements for all functionalities, including communications networks, continue to

change. As the network representation matures, specific data requirements will likely change also. The *Scenario Network Framework Documentation (TRAC-F-TM-10-040)* describes in more detail each of the M&S data requirements (required information for a scenario network framework) listed in the following table. AWARS and COMBAT XXI wargamers will use varying elements of the information provided in the required information databases.

Table 2. M&S Communications Required Information.

Required Information[15]	AWARS	COMBAT XXI
Overarching assumptions	Currently Required	Currently Required
Network systems book	Currently Required	Currently Required
Frequency overlap	Possible Future Requirement	Currently Required
Compatibility diagrams	Currently Required	Currently Required
For each echelon:		
Echelon assumptions	Currently Required	Currently Required
Equipment by task organization	Currently Required	Currently Required
Location of systems	Currently Required	Currently Required
Connectivity diagrams	Currently Required	N/A
Priority-of-use list	Possible Future Requirement	Possible Future Requirement
Frequency plan	Possible Future Requirement	Possible Future Requirement
Capabilities description	Currently Required	Currently Required

Way Ahead.

Each model has its own structure and communications methodology requiring the data in different formats. Also, as modelers continue to refine the representation of the communications network, additional data requirements may develop. Modelers must understand the specifications of the equipment as well as performance under certain conditions, whether there is communication with other devices, and the protocol of transmissions. These communications systems may be organic or allocated from pooled assets (higher HQ or ESB. For now, in each model for which a scenario is loaded, the format and specific data requirements must be generated. Databases must be established that contain all communications equipment with pertinent information. This will require a joint effort between those who use the models and those who provide the data.

[15] AWARS and COMBAT XXI data requirements will differ in levels of resolution. However, the baseline *Required Information* documented as part of the scenario's network framework will provide the basis from which to further develop the data requirements for each model at its particular level of resolution.

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Chapter 6 – Updating the Network Framework for Studies

Purpose.

This chapter describes how the scenario network framework may be updated and documented to support each study's unique needs. This chapter further describes recommended procedures for implementation.

Adjusting the Network Framework.

Two reasons for updating the framework before a study will either be that the study time frame changes – thus requiring a scenario update – or that the study issues drive changes to the scenario network framework. In either case, three changes to the framework could result: new equipment added, old equipment removed, and/or system characteristics changed. With the baseline scenario network framework in existence, this should take only a couple of weeks once there is an understanding of the changes. This requires updates and changes to the network information and the scenario network framework.

Depending on the echelon focus of the updates, changes may ripple into other elements of the framework data. The study team may use the required information compatibility, connectivity, frequency overlap, and frequency plans to help understand the effect of the changes. For example, a change to a SATCOM system affects the availability of satellite resources. The study team would review the list of echelon-based assumptions to ensure there are no impacts.

3) All of the development principles (top-down, sound assumptions, nodal approach, and analysis) and the process (strategic, corps-and-above, division-and-below, operational/mission assessment) remain the same as described in chapter 4.

Documentation Requirements.

Each study should document any changes to the scenario network framework as part of the study documentation. Formats similar to those in the *Scenario Network Framework Documentation (TRAC-F-TM-10-040)* are recommended to ensure a clear understanding and description of what was changed.

Implementation.

The study director should serve as the responsible party for coordinating and integrating network updates.

Summary.

The most critical element is ensuring that the study director clearly documents the changes to the scenario network framework as part of the study documentation.

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Chapter 7 – Summary

Purpose.

This chapter reviews the scenario network framework importance, summarizes the resourcing options available, and presents the recommendations for implementation.

Importance.

Establishing a scenario network framework greatly reduces the time required to establish a network architecture and design for studies and analyses. The scenario network framework ensures that limited resources, such as satellite access, ESB-provided equipment, UASs, and terrestrial relays, are appropriately represented in the network capabilities. The framework's holistic approach ensures that all communications and network capabilities are appropriately represented.

Resourcing.

The framework requires two key sets of information at the outset.

The first set is the detailed force task organizations and the operational scenario elements of upper-echelon organizations and locations, telecommunications infrastructures within the theater of operation, host nation and transit nation major cities and key facilities, and deployment schedules for theater units. The most effective method for development that ensures consistency with the scenario concept is for TRAC to assume responsibility for defining these elements and developing these starting conditions with the CONOPS.

The second set is the network information elements outlined in chapter 3. These comprise force structure, ARFORGEN, lists of equipment for the time frame, equipment descriptions, TOEs, procurement schedules, and BOIPs. Responsibility for these elements may belong to a TRAC scenario team or study team. Regardless, the responsible team depends on other organizations to provide the information. Thus, MOAs are required with U.S. Army Forces Command (FORSCOM), TCMs, PEOs, PMs, and HQDA G-8 to obtain the information as needed. TRADOC Architecture Integration and Management Directorate (AIMD) may also assist in gathering this information from the sources.

The scenario network framework should be fully integrated into the scenario development process and the scenario documentation. A team of operational network and communications planners, organized under a TRAC lead, should begin preparing the framework following the scenario CONOPS development and before the scenario conference.

The TRAC lead must be familiar with network capabilities and understand the process for development of required scenario products.

Framework development requires close ties with the operational signal experts resident at the SIGCOE. These experts understand the implementation and allocation of systems and resources for a mission – going beyond the technical aspects of designing and ensuring connectivity and capacity based on the ability of the systems. Support from system experts may also be needed. MOAs should be established with the SIGCOE and system experts to gain participation and support when needed.

The network framework may also be contracted, if funding is available, using this document and the *Scenario Network Framework Documentation (TRAC-F-TM-10-040)* as the basis for TRAC to follow in developing the statement of work for the deliverables of such a contract.

Tools such as NAIS will ease development of the framework. These tools, however, are secondary to the framework development.

Recommendations.

Two overarching recommendations resulted from this effort:

- Implement and resource the network framework within TRAC as described in this chapter. Previous study experiences from NT CBA and Assured Connectivity Analysis show the difficulty in establishing a network during study initiation. Each of these studies required much time to develop a robust network to conduct the study. As a result, time was taken away from the actual analysis and devoted to the "network build."
- Build brigade-and-above detailed scenarios (to include the network framework) for regions of the world (for example, Southwest Asia, Northeast Asia, and Africa) to create the operational foundation, network resource limitations, and infrastructure/backbone for the "tactical edge" networks. The tactical edge networks (brigade-and-below) could then be further developed in study-specific vignettes, establishing a more realistic and ready network for TRAC studies and analyses.

Appendix A – Scenario Documentation Requirements

Purpose.

This appendix lists and further describes the six types of operational scenario documentation requirements. It identifies the rationale for the requirements and presents examples of the documentation. The examples align with the *Scenario Network Framework Documentation (TRAC-F-TR-10-040),* which is the companion document to this paper.

Type 1. The theater and support force construct and their distribution throughout the task organization down to company and team level.

Rationale. A successful network framework requires a top-down approach. Because the network spans echelons and geographic and operational areas, establishing the infrastructure that the "tactical edge" networks depend upon is important. To fully represent the complexities of the network, representing realistic task organizations down to the company and team levels is important. Rarely, if ever, will "pure" brigade combat teams (BCTs) execute missions. Most major combat and stability operations require a task organization that attaches civil affairs and military information support operations (MISO) elements to maneuver brigades and battalions and augments maneuver enhancement brigades (MEBs) with various types of combat engineer, military police, and chemical operations support attachments. BCTs and divisions often operate with any number of attachments, or operational control (OPCON) or tactical control (TACON) forces, depending on mission, enemy, terrain and weather, troops and support available, time available, and civil considerations (METT-TC). Their communications capabilities and modernization levels often vary. Many missions also require OPCON adjustments throughout the task organization as the mission changes and the enemy creates challenges. These details documented in the operational scenario are critical to establishing an appropriate fighting force and the supporting network. Based on current fielding plans, there may be cases where Warfighter Information Network- Tactical (WIN-T) Increment (INC) 1b network capabilities are task organized into WIN-T INC 2 or 3 brigades, limiting the robustness of the WIN-T network in that brigade.

Example.[16] Figures A-1 and A-2 show the organization charts for Combined Joint Task Force (CJTF) Freedom and 7th Division with attached forces within the Multi-level Scenario (MLS).

[16] In this instance, the MLS documentation does provide this level of OPCON, TACON, and attachment information.

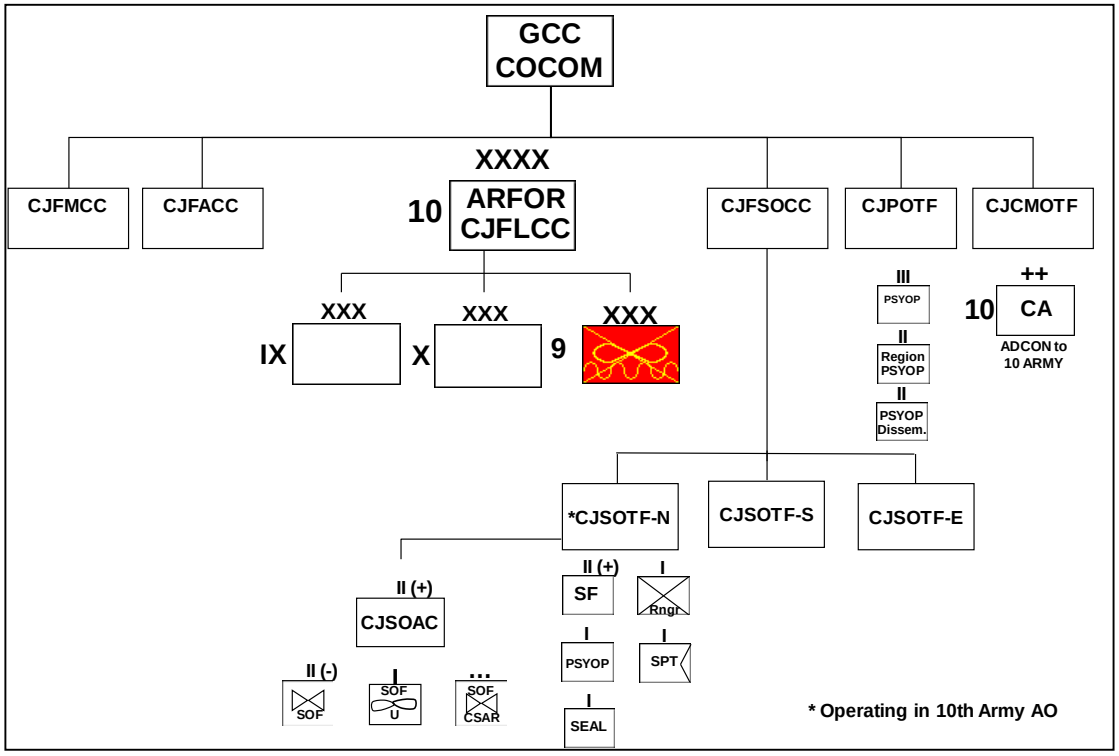


Figure A-1. MLS CJTF-Freedom Task Organization.

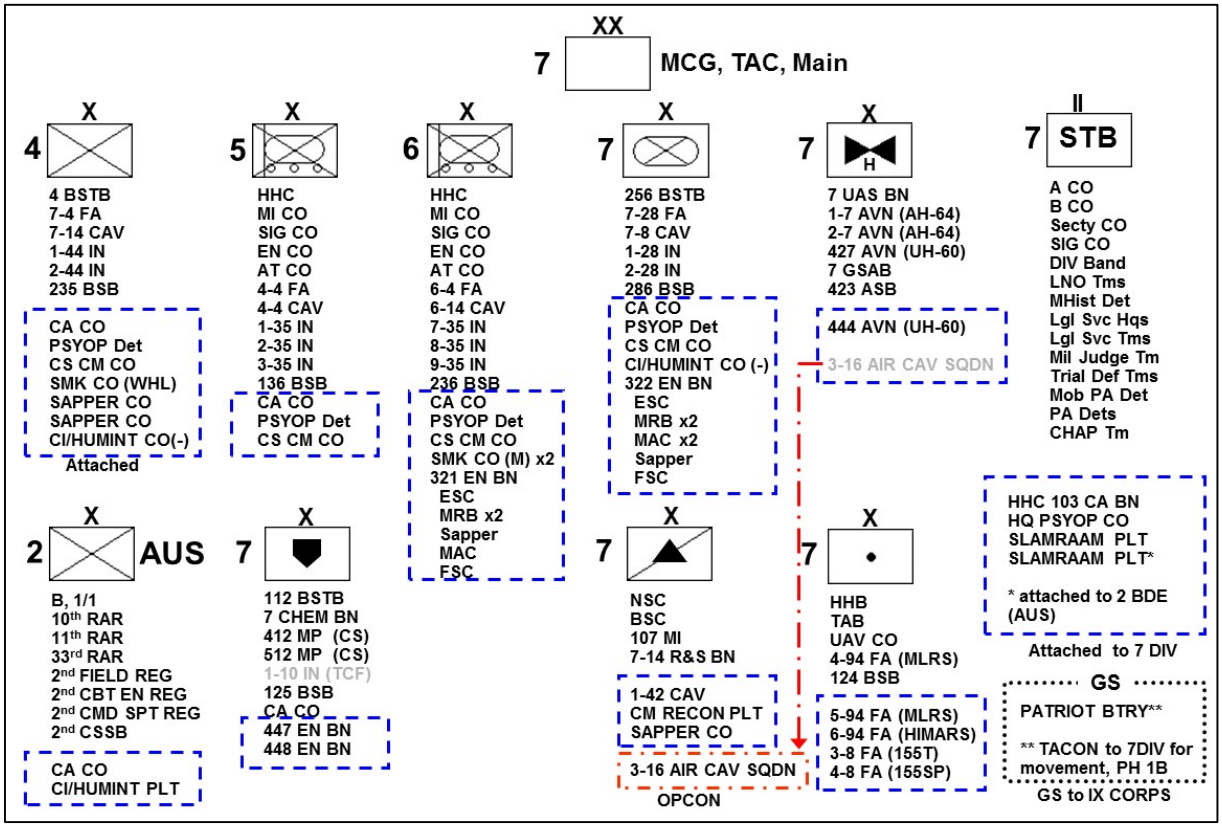


Figure A-2. 7th Division Task Organization.

Type 2. The telecommunications infrastructure within the theater of operation.

Rationale. Every operational scenario should provide an understanding of the telecommunications infrastructures within the countries where the joint task force (JTF) will operate, stage and transit through, and receive support. This telecommunications description, like the Geographical Area and Environment information provided in MLS 1.0, provides a key understanding of the operational environment. This information is important because it sets the stage for the types of communications infrastructures to which forces will transition as they deploy from their home stations. This infrastructure description provides a basis from which a network framework may be derived. Based on this information, assumptions may be derived for the scenarios that describe:

- Restrictions on operational force communications devices due to host/hostile nation operations,
- Availability of fiber and land-line communications for fixed corps and theater headquarters (HQ) elements,
- Potential interference issues due to host/hostile nation daily operations, and
- Scenario planning, discerning where to place critical corps and theater support HQ and other elements.

Example. This general infrastructure should be described in a similar fashion as in the World Fact Book, developed and distributed by the Central Intelligence Agency for U.S. Government officials. A derived example for Messenia in MLS 1.0 is:

> *The telecommunications system is the best developed, is the most modern, and has the highest capacity on the continent; it consists of carrier-equipped open-wire lines, coaxial cables, radio relay links, fiber-optic cable, and radio communications stations; key are the towns of Seattle, Spokane, and Portland; over 4,500,000 telephones; 2,254,000 cellular phone subscribers; broadcast stations - 190 AM stations, 406 FM stations with 134 repeaters, 100 television stations with 1297 repeaters with 530,000 radio sets and 497,000 TV sets in use (45% cable access, 25% satellite access, 50% antenna access); 3 communications satellite earth stations operating in Intelligent Satellite Communication Solutions (INTELSAT) (Atlantic Ocean and Pacific Ocean); main internet access is available (wired and wireless)in Seattle, Spokane, and Portland; the rest of the country's access is sporadic.*

Type 3. Locations of all theater-related HQ and theater support force structures, including U.S. Combatant Command (COCOM), coalition, and multinational supporting HQ.

Rationale. Often, operational scenarios present pictures of the area of operation (AO) and representative missions with associated operational graphics. The basic locations of the many related theater HQ elements and theater support forces are missing. Sometimes, information regarding the corps HQ locations is not provided. Mission graphics alone are not enough from which to derive locations for the purposes of establishing the network communications between the corps-and-below HQ and all other related elements. It is important to separate the force structure elements into the appropriate locations to ensure the network framework represents the distances and needed interactions between separate communicating force structure locations.

Example. At a minimum, locations should designate approximately where the theater and corps elements are. For MLS, as established for the Network Transport (NT) Capabilities Based Assessment (CBA), the following positions would be sufficient if latitude and longitude locations were unavailable:

- 10th Army Main: outside Ellensburg, WA, Messenia.
- 10th Army Area Support Group (ASG): Joint Base Lewis-McChord, WA, Messenia.
- 10th Aviation Command (AVCOM) Headquarters (HQ): Joint Base Lewis-McChord, WA, Messenia.
- 10th Engineer Command (ENCOM) HQ: outside Snoqualmie, WA, Messenia.
- 30th Expeditionary Signal Command (ESC) HQ: outside Olympia, WA at Lacey, WA, Messenia.
- 10th Medical Deployment Support Command (MDSC) HQ: outside Buckley, WA, Messenia.
- 10th Maneuver Enhancement Brigade (MEB) HQ: south of Yakima, WA, Messenia.
- IX Corps Main: Cheyenne, WY, Messenia.
- 4th Division Main: south of Fort Morgan, CO, Messenia.

Type 4. Locations of host nation and transit nation capital, major cities, and critical facilities throughout the AO.

Rationale. Operational graphics for the scenarios are not enough to clearly distinguish where the capital cities are for host nation, friendly, and enemy nations or nation states. It is important to know the locations of major cities to identify the communications infrastructures used within the AO. These cities potentially affect the network framework by providing critical landline and fiber infrastructures for use either by the operating forces, or by presenting key areas of communications frequency interference due to the existing television, radio, or cell phone use of those cities.

Example. See example in item 3, above.

Type 5. Locations for all key objectives and cities in the area of responsibility (AOR).

Rationale. Within each AOR, for specific missions, the above information should be identified in more detail, allowing analysts to determine the complexities of potential electromagnetic interference (EMI), should the study require this.

Example. See example in item 3, above.

Type 6. Deployment schedule for theater units.

Rationale. Deployment of units into theater is vital if any network study is to be comprehensive. Especially in an austere theater with limited infrastructure, network planners must take into account the desired deployment of maneuver and support units when assessing what network capabilities need to be provided over time and where. Network components must be assessed, especially for network operations and network management, over the deployment timeline, as the units arrive and as they enter the network. Under the Network Service Center (NSC) concept, units are either already in the network at home station before deployment or are absorbed upon

mobilization (especially United States Army Reserve (USAR) and Army National Guard (ARNG) units not currently in the Army network). While units move from home station to power projection platforms and deploy forward, each station along the way must provide a basic set of network capabilities that the unit can tie into to sustain its situational awareness, planning, and self-monitoring/mission command tasks, among others. The NSC ensures file transfers from the units' home stations to their deployed locations and assists or provides network access for appropriate nodes and users through the Army processing center (APC) and theater assets. The deployment schedule enables assessment of NSC capabilities over time. The schedule also provides the network framework developers the ability to assess sufficiency of expeditionary signal battalion (ESB) and other theater assets (standard tactical entry point (STEP)/teleport requirements, integration with non-U.S. networks, etc.). Deployment schedules also are required for other warfighting function analyses.

Example. The segment of the MLS deployment schedule shown in table A-1 was developed in support of TRAC's NSC Bandwidth Study performed for Chief Information Office (CIO)/G6. Critical information includes:[17]

- Organization and unit – the scenario unit type, echelon, and name/designation.
- Origin – unit home station before deployment. Likely will require the unit to move to a power projection location before departing aerial ports of debarkation (APODs) and seaports of debarkation (SPODs).
- Implementation day (I-day) – the day intelligence indicators are recognized leading to operational plan (OPLAN) initiation.
- Commencement day (C-day) – the unnamed day on which a deployment operation commences or is to commence. The deployment is movement of troops, cargo, weapon systems, or a combination of these elements using any or all types of transport.
- D-day – the unnamed day on which a particular operation commences or is to commence.
- G-day – the date of the order to deploy.
- The latest arrival date (LAD) – a day, relative to C-day, which the planner specifies as the latest date when a unit, a resupply shipment, or replacement personnel can arrive and complete unloading at the port of debarkation and support the concept of operations.
- Closure date – the date the unit fully closes in theater, but not necessarily at a marshaling area or reception, staging, onward movement and integration (RSOI) location (CONOPS).
- Days late – the number of days beyond the LAD when the unit closed in theater.
- Days early – the number of days before the LAD when the unit arrived in theater.

[17] Chairman of the Joint Chiefs of Staff Manual (CJCSM) 3122.01 Joint Operation Planning and Execution System (JOPES).

Table A-1. Deployment Schedule (Segment).

Organization	Unit	Origin	I Dates	C-Dates	NLT D-Dates	G Dates	LAD	**Closure Date**	**Days Late**	**Days early**
Theater MP Command	10 MP Command	Lansing, MI	I+10	C+1	D-23	G-33	D-23	**D-39**		**16**
Theater Info SPT CMD	10 TISC/10 TIB	Ft. Sam Houston, TX	I + 5	C-4	D-26	G-36	D-26	**D-33**		**7**
Theater AVN COMMAND	83 TASMG	Springfield, MO	I + 9	C-Day	D-24	G-34	D-24	**D-30**		**6**
Theater AVN Support BDE	10 TASB	Ft. Sheridan, IL	I+10	C+1	D-23	G-33	D-23	**D-29**		**6**
EOD	10 EOD GRP (-)	Fort Carson, CO	I + 12	C+3	D-21	G-31	D-21	**D-29**		**8**
IBCT (APS-3)	3 IBCT	Ft. Campbell, KY	I + 13	C+4	D-20	G-30	D-20	**D-29**		**9**
CA BDE	25 CA BDE	Philadelphia, PA	I + 13	C+4	D-20	G-30	D-20	**D-29**		**9**
EOD	10 EOD GRP (-)	Fort Carson, CO	I+36	C+27	D+3	G-7	D+3	**D-29**		**32**

Appendix B – Network Information

Purpose.

This appendix lists the seven types of network information described in the main report and describes the relevance of the information to the scenario and the network framework. This appendix also identifies the perishability of the information, the authoritative sources and recommended procedures on how to ensure updated information is available for use, and how to store that information for future use.

Type 1. Force Structure.

This information is the product of the Total Army Analysis (TAA) and the Program Objective Memorandum (POM) processes. Force structure is apportioned among four components (COMPOs): the Active Army (COMPO-1), the Army National Guard (ARNG) (COMPO-2), the U.S. Army Reserve (USAR) (COMPO-3), and unresourced unit equivalents (COMPO-4).[18] This network information is needed to understand the quantities of Army units by type and time frame. Of particular interest are the expeditionary signal battalions (ESBs) available for signal support. The list of available ESB units for a given time period may be published or distributed in many documents or forms. The preferred form is the Army Structure (ARSTRUC) Memorandum for a particular time frame. The memorandum lists the standard requirements codes (SRCs) for the units in the Army force structure. The SRC is important when researching table of organization and equipment (TOE) or modified TOE (MTOE) data.

Relevance to the Scenario. The scenario documentation must be detailed enough to present the complexities of the Army force structure. Complexities in operations and mix of forces (for example, COMPOs; brigade types; special operations; and joint, interagency, intergovernmental, and multinational (JIIM)) should be specified and developed based on emerging study issues, or at a minimum, the scenario documentation should provide the framework to further develop these forces in greater detail for future studies.

Relevance to the Network Framework. The force structure complexities are critical to fully analyze network capabilities and to adequately represent real-world capabilities in U.S. Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC) studies and analyses. Brigade combat teams (BCTs) are usually the most modernized of the Army's forces. Therefore, network/communications with attached or supporting functional and support brigade assets have limitations. ARNG and USAR forces are also not as modernized as active duty forces. Representing the interoperability of these types of units in the network framework is essential to highlighting real-world capabilities and their limitations.

Information Perishability. Force structure information is usually published annually and within three months of the start of a fiscal year. The most recent published document should replace all others and serve as the reference document. In the event of emerging substantial changes to Army force structure, representing draft versions of the force structure may be important. In the case of emerging structures, the "as of" date is critical and should be obtained and documented immediately before use.

[18] Army Regulation 71-11, Total Army Analysis (TAA), 29 December 1995, p 1.

Source. The authoritative source is Office of the Director, Force Management (FM), G-37/FM, Headquarters, Department of Army (HQDA). The ARSTRUC documentation is available at Army Knowledge Online (AKO). If emerging substantial changes must be represented in a study, the study team should contact Director, Force Design Directorate (FDD), Army Capabilities and Integration Center (ARCIC). The Future Forces Data Base referenced in TRADOC Regulation 71-4 is still immature but is a potential future source for the out-year force, units, and equipment data. This database is published through the Joint Data Support site.[19]

Recommended Update Procedures. No update procedures are required for this information. The approved version is available on AKO, or the most recent information may be obtained from FDD just before use.

Storage. Availability of the approved versions on AKO eliminates the requirement for TRAC storage. However, when using the emerging changes to the force structure, the source document should be stored in the project data folder with the "as of" date embedded in the document name.

Type 2. Army Force Generation (ARFORGEN) Schedule. The ARFORGEN schedule provides information on the availability and modernization of the Army force structure. Particularly interesting is the availability of the ESBs for deployment. The ARFORGEN information also provides a gauge for the quantity and COMPO status of the force structure in the scenario. Supplying a mix of COMPO types in the scenario force structure is the best way to truly analyze a realistic force. Often, the COMPO-2 and -3 units have different network and communications equipment than the Active Army. With these mixes of capabilities, ESB support may vary and communications interoperability between units may be affected.

Relevance to the Scenario. The ARFORGEN schedule provides a realistic list of units available for deployment. These units are a mix of COMPOs for representation in the scenario. This provides a more realistic representation of capabilities across the force for analysis.

Relevance to the Network Framework. Previous network framework experience shows that for a major combat operation (MCO) more ESBs are required to support the operation than are available through ARFORGEN. Therefore, additional ESBs provided outside the ARFORGEN schedule may have degraded capabilities when providing signal support to the force.

Information Perishability. Based on the research supporting this paper, the perishability of the ARFORGEN data are unclear. Each delivery of ARFORGEN data must also include the perishability conditions for the usefulness of the data.

Source. The U.S. Army Forces Command (FORSCOM) ARFORGEN Synchronization Tool (AST) provides a means for the Army to have a collective, common view of ARFORGEN from the unit through the service level.

Recommended Update Procedures. At the time of publication, sufficient coordination to make a recommendation for updating this information has not been accomplished with FORSCOM.

Storage. This depends on AST availability and access.

Type 3. Network Equipment List. This list is critical to the development of the network framework. It should encompass all current communications and network transport equipment in

[19] TRADOC Regulation 71-4, p 14.

the force and the planned and programmed systems that have entered into the military acquisition process. To be useful for network framework development, this list must include the following:

- Program Name. The program name is the overarching program title and short (common) name for each communications or network transport system/equipment. If the system/equipment is a component of a larger set (for example, rifleman radio as a part of the Joint Tactical Radio System (JTRS)) or the system/equipment has incremental capability fielding (for example, Warfighter Information Network – Tactical (WIN-T) Increments (INCs) 1 through 3), then separately listing the system/equipment by component and by increment is important. Identifying the peripheral equipment (for example, antennas and generators) in this part of the network information is unnecessary. Complications in names and nomenclatures,[20] particularly for current systems and equipment that have had many improvements, updates, and fielding, make obtaining the program name difficult. The key is to simplify the information to a manageable and understandable set. For example, Single Channel Ground and Airborne Radio System (SINCGARS) communications radios come in many forms (for example, portable variants like the Army nomenclature (AN)/Portable Radio Communications (PRC)-119 and vehicular variants like the AN/ Vehicular Radio Communications (VRC)-87).[21] Simplifying the various forms into portable (man-packed or hand-held) versus vehicle-mounted may be the best way to distinguish the variations rather than listing each specific type of SINCGARS. When this is done, however, all of the associated names and nomenclatures must be identified as elements of this program name.
- Line Item Number (LIN). The LIN is "a 6-character alphanumeric identification of generic nomenclature" that "pertains to the line on which the generic nomenclature is listed … in Army equipment authorization documents."[22] Complications in program names pale in comparison with the LIN listings.[23] Finding the appropriate LINs for the communications and network transport systems and equipment during the Network Transport Capabilities-Based Assessment (NT CBA) often proved insurmountable, particularly when the systems/equipment were in Army inventory for many years with many procurements and variations. The LIN is important because it provides a direct link in finding the equipment in tables of organization and equipment (TOEs). However, systems and equipment in the acquisition process do not have LINs until procured.
- Availability Dates. The availability dates identify, at least to calendar or fiscal year accuracy, when the system/equipment is expected to be fielded and operational, and its expected "removal from inventory" date. This is important to identifying the appropriate systems/equipment for the scenario. If the program name is equipment in use today, then the availability date should state "current" followed by the date when the system/ equipment is expected to be retired. For future equipment progressing through the acquisition system, the availability date should state the expected initial operational

[20] LTC James Bates, "Names, Numbers and Nomenclatures," Army Logistician, Sep-Oct 2004 (http://www.almc.army.mil/ALOG/issues/SepOct04/numbers.html).
[21] Be cautious of systems/equipment called SINCGARS and other systems/equipment like JTRS or multiband inter/intra team radio (MBITR) that use the SINCGARS waveform to communicate.
[22] Cataloging of Supplies and Equipment, Army Adopted Items of Materiel and List of Reportable Items (SB 700-20), Department of the Army Pamphlet 708-3, 15 October 2000, para 3-11, p 9.
[23] Bates.

capability (IOC) date or an indication that the availability is not known. Study teams will have to make assumptions in later uses of the network scenario information of the availability of undetermined IOC systems.

- Replacement System/Equipment. For the system/equipment with "ending" availability dates, the equipment expected to replace it should be identified. When developing or updating this information, the team should conduct a cross-check and ensure that the start date for the replacement equipment is congruent with the end date of the item replaced.

Relevance to the Scenario. The list of information transport and communications equipment with their availability dates provides an idea of the communications and network capabilities available for course of action (COA) selection and planning.

Relevance to the Network Framework. Scenario development depends on the list of available equipment for the time frame of the scenario to begin building the network framework. Without this list and valid availability dates, the network framework cannot be realistically built for the scenario timeframe.

Information Perishability. To date, a good assumption is that all equipment will remain in the force until it is no longer sustainable. If equipment is "replaced," it is often sent to other units or COMPOs. Therefore, finding an actual date for when the equipment will leave Army inventory is rare. The most perishable data are the IOC dates for new acquisitions. These dates must be checked at least every six months. Updating this list every six months should be synchronized with the capability set decision schedules once in place.[24]

Source. These data must come from TRADOC capability managers (TCMs) for new or future equipment in the acquisition process and from the appropriate Army Materiel Command or TRADOC representative for existing equipment. For example, Trojan Spirit is "owned" by the intelligence community, so a point of contact at the Capabilities Development and Integration Directorate (CDID), US Army Intelligence Center at Fort Huachuca, will have the current plans for this piece of equipment.

Recommended Update Procedures. Establish memorandums of agreements (MOAs) with the source agencies (which vary depending on the equipment). The MOA must prescribe the six-month update schedule in January and June every year. Recommend maintaining data in an Excel spreadsheet that is easy for multiple organizations to update.

Storage. This file, including an "as of" date, must be stored in a common place on TRAC AKO or SharePoint files for access by all TRAC organizations.

Type 4. Equipment Descriptions.

Equipment descriptions are best captured in a systems book (as described in the *Scenario Network Framework Documentation (TRAC-F-TR-10-040)*). The systems book should contain, at a minimum, the elements listed below. If the information is planned to change (for example, threshold to objective requirements), the time frame for those changes and the specific upgrades should be documented.

- System reference information (for example, name, picture, LIN and points of contact).

[24] Draft Execution Order: M&S-Enabled Network Analysis to Support Decision-Making, GEN George W. Casey Jr., Chief of Staff, U.S. Army, 30 June 2010.

- Fielding information (e.g., force distribution, availability dates, replacement system).
- Physical descriptions (for example, security classification, implementation range, component descriptions, technical specifications, interoperability, network operations and network management capabilities, sustainment requirements). Component descriptions are, for example, antennas, modems, and power. Technical specifications may include channel access, frequencies, capacities, polarization, links, and waveforms. Sustainment requirements examples are personnel, shelters, and transport equipment such as vehicles or transit cases.
- Operational considerations (e.g., set-up/tear-down times, electromagnetic pulse (EMP) protection requirements, and description of normal operational use).

Relevance to the Scenario. This information is similar to the Multi-level Scenario (MLS) threat's Attican Equipment Guide found in the MLS 1.0 documentation. This information should also be incorporated into the weapons, munitions, and sensors list (WMSL) of the scenario.

Relevance to the Network Framework. The equipment descriptions support the development of the various network framework products. Connectivity assessments, compatibility diagrams, frequency plans, priority-of-use plans and resulting capability descriptions of the network framework are dependent on the equipment descriptions.

Information Perishability. This information does not change as often for a particular system as the availability dates for the equipment list. Annual updates to the systems book are sufficient to maintain accuracy unless one particular system is the focus for a study. In this event, the study team must review the system book information before use.

Source. A different source exists for each system, but the source should coincide with the source of the equipment list and system availability dates.

Recommended Update Procedures. Establish MOAs with the source agencies (which vary depending on the equipment). The MOA must prescribe the annual update schedule. This systems book (recommended as a Word document) should also be supported with multiple technical documents and summary information for that system.

Storage. This file, including an "as of" date, must be stored in a common place on TRAC AKO or SharePoint files for access by all TRAC organizations.

Type 5. TOE. TOE data are accessed through Capabilities Assessment Development and Integration Environment (CADIE) and Architecture Based Capabilities Assessment Software (ABCAS). TRAC's Network Architecture Integration Service (NAIS) concept may be used to link to existing TOEs during the scenario development process. Some units update their structure and equipment through documentation, such as the Fort Knox Supplemental Manual 71-8.

Relevance to the Scenario. The TOEs (whether TOE, modified TOE (MTOE), or objective TOE (OTOE)) are critical to the entire scenario development process, not just the network framework. The organic equipment in each unit is used to develop the scenario's WMSL as well as the network framework.

Relevance to the Network Framework. TOEs provide the organic equipment for each unit. The TOE sets the baseline for the communications and network transport equipment available to be used to build the network.

Information Perishability. If accessed through CADIE/ABCAS, the best-available TOE is there. The TOE equipment lists are then augmented by equipment in the acquisition process, equipment from attached or OPCON units, or Expeditionary Signal Battalion (ESB)-provided equipment. As described in chapter 3, these TOEs are often not recently updated, not representative of future time frames, and difficult to translate from components to communications systems. Therefore, when pulling these TOEs, the study team must always review and update to ensure accuracy.

Source. CADIE/ABCAS pulls from the primary source – United States Army Force Management Support Agency (USAFMSA), whose responsibility is to document manpower and equipment requirements and authorizations for the Army.

Recommended Update Procedures. Pull the latest TOEs through CADIE/ABCAS at the start of each scenario development and update with any unit documentation, such as Fort Knox Supplemental Manual 71-8.

Storage. TOEs require no storage; this information is available directly from the source through CADIE/ABCAS.

Type 6. Procurement Schedules. A procurement schedule shows the allocation of future network and communications equipment across the force structure (by time frame). It describes the current plan for purchasing and fielding the future equipment – by calendar or fiscal year – for distribution across the force structure, by unit. A sample spreadsheet (table B-1) is shown below for Joint Tactical Radio System (JTRS) planned allocations. The spreadsheet carries out the procurement schedule until fiscal year (FY) 2028. This information is needed for each network and communications system/equipment in the acquisition process. Not every procurement schedule will take this form.

Relevance to the Scenario. The procurement schedules for future equipment ensure a realistic representation of new capabilities across the force. A scenario should not provide new equipment to all units if the procurement schedule shows limited distributions for that time frame. Accordingly, assumptions should be made to explain why the units in the scenario are those receiving the new equipment, such as the units being the main effort for the theater operation.

Relevance to the Network Framework. Realistic distributions of new equipment are particularly important for communications and network equipment because of interoperability issues between new and current equipment. Assumptions are required to explain why the units selected are those receiving the latest procurements.

Information Perishability. This information changes at least during each Program Objective Memorandum (POM) cycle.

Source. The best source for this information is HQDA G-8. Other organizations may have this information available, but HQDA G-8 is the authority on final procurements.

Recommended Update Procedures. These schedules should be reviewed with each capability set decision in January and July and updated as necessary.

Storage. Store this information in spreadsheet form accompanied with the equipment descriptions and basis of issue data with an “as of” date.

Table B-1. Procurement Schedule for JTRS by Brigade Type.

Services		Major Unit / Platform Types Services Field	Total Force Pool	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18
Army	BCTs	EIBCT (E/LDM)	3	0	2	1	0	0	0	0	0	0
		EIBCT	19	0	0	2	6	5	3	0	0	3
		IBCT	21	0	0	0	0	2	4	6	8	1
		HBCT	24	0	0	0	0	0	0	0	0	1
		SBCT	9	0	0	0	0	0	0	0	0	0
	MF SPT BDEs	CAB	20	0	0	0	0	0	0	0	0	1
		BfSB	10	0	0	0	0	0	0	0	0	0
		ME (CSB)	21	0	0	0	0	0	0	0	0	1
		Fires	14	0	0	0	0	0	0	0	0	1
		Sustainment	32	0	0	0	0	0	0	0	0	1
	HQs	Div Hq	18	0	0	0	0	0	0	0	0	1
		Corps Hq	4	0	0	0	0	0	0	0	0	0
				0	0	0	0	0	0	0	0	0
	Functional Bdes	ADA	7	0	0	0	0	0	0	0	0	0
		AFSB	11	0	0	0	0	0	0	0	0	0
		CHEM	3	0	0	0	0	0	0	0	0	0
		CSB	7	0	0	0	0	0	0	0	0	0
		GMD	1	0	0	0	0	0	0	0	0	0
		IO	4	0	0	0	0	0	0	0	0	0
		MED	14	0	0	0	0	0	0	0	0	0
		MP	11	0	0	0	0	0	0	0	0	0
		MP CID	2	0	0	0	0	0	0	0	0	0
		MI	8	0	0	0	0	0	0	0	0	0
		OD (EOD)	3	0	0	0	0	0	0	0	0	0
		QM (POL)	4	0	0	0	0	0	0	0	0	0
		RSG	42	0	0	0	0	0	0	0	0	0
		SIG	12	0	0	0	0	0	0	0	0	0
		Space	1	0	0	0	0	0	0	0	0	0
		TASM-G	4	0	0	0	0	0	0	0	0	0
		TAVN	7	0	0	0	0	0	0	0	0	0
		ENG	16	0	0	0	0	0	0	0	0	0
			157	0	0	0	0	0	0	0	0	0
				0	0	0	0	0	0	0	0	0
				0	0	0	0	0	0	0	0	0
	AVN Platforms	AVN Platforms		0	0	0	0	0	0	0	0	0
		AVN Platforms		0	0	0	0	0	0	0	0	0
		AVN Platforms		0	0	0	0	0	0	0	0	0
		AVN Platforms		0	0	0	0	0	0	0	0	0
				0	0	0	0	0	0	0	0	0
	TOTAL			0	2	3	6	7	7	6	8	10

Type 7. Basis of Issue Plan (BOIP). BOIPs describe, in quantitative terms, the doctrinal groupings of personnel and equipment for Army organizations. This information shows specifically who has what equipment within a unit. TCMs develop BOIPs for future equipment. This complements the TOE data showing the organic equipment. If future year TOEs are used, the TOEs likely are not current. The study team should always compare the newest BOIP from the TCM with the future year TOEs, and use the BOIP attained from the TCMs as the latest and most current data. A sample WIN-T BOIP is shown in table B-2.

Relevance to the Scenario. The location of equipment is critical to all scenarios to realistically represent the capabilities for the scenario timeframe.

Relevance to the Network Framework. Realistic distributions of new equipment are particularly important for communications and network equipment because of the interoperability issues between new and current equipment. The BOIP, down to the Soldier level, helps the network

framework developers create the detailed network structures for “command nets,” “fires nets,” and “intelligence nets.”

Information Perishability. BOIPs must change when procurement schedules or unit force structures change. The problem is that the BOIPs often lag because of their detailed nature and dependency on the other items. These data need to be checked at least semi-annually and reviewed every time the procurement schedules or the force structures change. Old BOIPs may need to be updated in the network framework development.

Source. TCMs are the developers of, or greatly involved in, the working groups that develop the data for future equipment. Study teams must check for potential changes in current equipment from the same organizations as the equipment descriptions data.

Recommended Update Procedures. Sources should be consulted semiannually (in conjunction with the capability set decisions) for potential changes.

Storage. The BOIP should be stored with the procurement schedules and equipment description data for easy access, with an “as of” date.

Table B-2. HBCT WIN-T Increment 3 Basis of Issue.

Updated 25 Jan 2010	Brigade Combat Team - Heavy								
Fielding for Increment 3	BDE TAC	BDE Main	Mvr Bn#1	Mvr Bn#2	RSTA SQDN	Fires Bn	BSB	BSTB	BDE TOTAL
TCN v2	1	1	1	1	1	1	1	1	8
POP-C	1	1	0	0	0	0	0	0	2
POP v2	0	0	1	1	1	1	1	0	5
SNE	0	0	6	6	7	6	4	4	33
QT/LA	0	0	0	0	0	0	0	0	0
STT+	1	1	1	1	1	1	1	1	8
TR-T v2	0	1	0	0	0	0	0	0	1
VWP v2	1	1	2	2	2	2	0	0	10
NOSC v2	0	1	0	0	0	0	0	0	1
MCN-TS	1	0	1	1	0	0	0	0	3
MCN-B	0	1	0	0	0	0	0	0	1
JGN v2	0	0	0	0	0	0	0	0	0
MVTC	1	1	1	1	1	1	1	1	8
PCD	61	0	0	0	0	0	0	0	61
IP Phone	130	0	0	0	0	0	0	0	130
Secure IP Phone	55	0	0	0	0	0	0	0	55

Type	POP Distro	Vehicle Type
POP-C	BDE CDR	M2 / HMMWV
POP-C	BDE S3 SEC	M1068
POP V2	MVR BN #1 CDR	M1068
POP V2	MVR BN #2 CDR	M1068
POP V2	RSTA CDR	M1068
POP V2	FA BN CDR	HMMWV
POP V2	FSB CDR	HMMWV
	7	

VWP Distro	Vehicle Type
BCT TAC CPP	HMMWV
BCT MAIN CP CPP	HMMWV
MVR BN #1 S3 SEC	M1068
MVR BN #1 FSE	M1068
MVR BN #2 S3 SEC	M1068
MVR BN #2 FSE	M1068
RSTA FSE	M1068
RSTA S3 SEC	M1068
FA BN S3 SEC	M1068
FA BN FDO	M1068
10	

Type	SNE Distro	Vehicle Type
SNE	MVR BN #1 S3 OFF	M2 / HMMWV
SNE	MVR BN #1FM RETRANS	HMMWV
SNE	Rifle CO A CP	M113
SNE	Rifle CO B CP	M113
SNE	Armor CO C CP	M113
SNE	Armor CO D CP	M113
SNE	MVR BN #2 S3 OFF	M2 / HMMWV
SNE	MVR BN #2 FM RETRANS	HMMWV
SNE	Rifle CO A CP	M113
SNE	Rifle CO B CP	M113
SNE	Armor CO C CP	M113
SNE	Armor CO D CP	M113
SNE	RSTA S3 OFF	M3 / HMMWV
SNE	RSTA FM RETRANS #1	HMMWV
SNE	RSTA FM RETRANS #2	HMMWV
SNE	RSTA FM RETRANS #3	HMMWV
SNE	RSTA TRP A CP	M1068
SNE	RSTA TRP B CP	M1068
SNE	RSTA TRP C CP	M1068

Type	SNE Distro	Vehicle Type
SNE	FA BN S3 SEC	M1068
SNE	FA BN FM RETRANS	HMMWV
SNE	FA BTRY A PLT FDC #1	M1068
SNE	FA BTRY A PLT FDC #2	M1068
SNE	FA BTRY B PLT FDC #1	M1068
SNE	FA BTRY B PLT FDC #2	M1068
SNE	SIG CO RETRANS #1	HMMWV
SNE	SIG CO RETRANS #2	HMMWV
SNE	SIG CO RETRANS #3	HMMWV
SNE	ENG CO CP	M113
SNE	ARS FSC OPS	M1068
SNE	FA BN FSC OPS	M1068
SNE	MVR BN #1 FSC	M1068
SNE	MVR BN #2 FSC	M1068
	33	

Appendix C – Network Framework Development Process

Purpose.

Appendix D presents checklists of items from which to develop the network framework for a scenario. Refer to the Network Framework Process in chapter 4 for a full description of the four steps below before executing the checklists. Recommendations on how the checklist items fit within the scenario development process are also provided. Refer to chapter 4, Framework Implementation paragraph, to understand how the framework is implemented in the scenario development. Some items listed below can be developed in parallel with other items– but most important to the process is to endure the integration with the overall scenario development process. When executed in conjunction with the scenario development process, the checklists assume that region, time frame, mission, task organization, and concept of operations (CONOPS) have been established by the U.S. Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC). Adjust the checklists to adequately support the scenario under development. If certain elements are not the key focus of the scenario, then developing assumptions rather than the network framework for those elements is sufficient. The only exception is satellite allocation and availability, which will directly affect any network representation from theater to company level, and sometimes below company.

Step 1. Establish the strategic infrastructure for the theater of operations. See table C-1. All actions are executed prior to the scenario conference.

Step 2. Establish the theater and corps network framework. See table C-2.

Step 3. Establish the division-and-below network framework. See table C-3.

Step 4. Evaluate changes to the network. The checklist for this step should include the checklists from the three previous steps at all points in the scenario operation (mission) where key changes in network support will occur.

Table C-1. Strategic Infrastructure Checklist.

	ACTION	SCENARIO DEVELOPMENT PROCESS
	Prior to the scenario conference (during initial CONOPS development)	
☐	Identify the Framework Assumptions.	Development Principles
☐	Describe the strategic and theater infrastructure – describe fiber from the United States running into theater and usable host nation fiber and landline infrastructures.	Overarching Network Assumptions
☐	Describe the availability of spectrum across the theater of operations, and identify any key issues related to electromagnetic interference across the theater of operation.	Overarching Network Assumptions
☐	Describe and/or develop the network/communications support to coalition forces as well as interagency, intergovernmental, nongovernmental, and private volunteer organizations.	Overarching Network Assumptions and/or Locations of Systems
☐	Identify the military satellite coverage with designated distributions and usage assumptions for the channels and beams.	Overarching Network Assumptions and/or Locations of Systems
☐	Identify any dependencies on commercial satellite coverage.	Overarching Network Assumptions and/or Locations of Systems
☐	Locate and describe supporting standard tactical entry points (STEPs) and teleports.	Overarching Network Assumptions and/or Locations of Systems
☐	Describe the effect of network operations (NETOPS) on the overall network (for example, percentage of capacity it consumes, priority of NETOPS traffic, encryption, and user access).	Overarching Network Assumptions
☐	List all Overarching Network Assumptions.	Development Principles
☐	Summarize step 1 in a short "capabilities"[25] description of the network.	Capabilities Description

[25] A "capability" is defined (for the purposes of this report) as the manifestations the *network framework* has on the force's ability to perform its mission(s).

Table C-2. Theater and Corps Network Framework Checklist.

	ACTION	SCENARIO DEVELOPMENT PROCESS
	Prior to the scenario conference (during initial CONOPS development)	
☐	Describe the Network Service Center (NSC) concept for the theater of operation, to include the locations of the Army processing centers (APCs), regional hub nodes (RHNs), and Theater Network Operations and Security Centers (TNOSCs).	Theater-level Assumptions, Locations of Systems, Equipment by Task Organization, Connectivity Diagrams
☐	Identify the quantity of ESBs needed to support the theater of operation.	Theater-level Assumptions, Scenario Task Organization and Equipment by Task Organization
☐	Identify the organic communications equipment for corps-and-above assets and headquarters.	Equipment by Task Organization and Locations of Systems
	During the scenario conference	
☐	Distribute ESB support to corps-and-above units.	Equipment by Task Organization and Locations of Systems
☐	Develop and describe the satellite terminal usage and connectivity plans for corps-and-above units, e.g., terminals used for reach back; terminals connecting the corps-and-above units; terminals connecting to lower echelons.	Corps-and-above Assumptions and Connectivity Diagrams
☐	Estimate connectivity for all other corps-and-above ESBs and organic equipment.	Connectivity Diagrams
☐	Analyze threat network attacks and describe the effects on the force.	Corps-and-above Assumptions
☐	Develop how information transverses the network & in what order (varies based on originator/content).	Priority of Use List
	After the scenario conference	
☐	Develop uplink and downlink availability for satellite terminals based on satellite availability.	Frequency Plan
☐	Analyze capacity limitations of satellite terminals and other equipment based on network design and resource limitations (e.g., satellites).	Corps-and-above Assumptions
☐	Analyze & describe friendly force & host nation EMI impacts on the force.	Corps-and-above Assumptions
☐	Analyze connectivity for all other corps-and-above ESB and organic equipment.	Connectivity Diagrams
☐	Complete the list of Corps-and-above Assumptions.	Development Principles
☐	Summarize step 2 in a short “capabilities” description of the network.	Capabilities Description

Table C-3. Division and Below Network Framework Checklist.

	ACTION	SCENARIO DEVELOPMENT PROCESS
	Prior to the scenario conference (during initial CONOPS development)	
☐	Identify the organic communications equipment for division-and-below units and headquarters.	Equipment by Task Organization and Locations of Systems
	During the scenario conference	
☐	Distribute ESB support to division-and-below units.	Equipment by Task Organization and Locations of Systems
☐	Develop and describe the satellite terminal usage and connectivity plans for division-and-below units, e.g., terminals used for reach back; terminals connecting the division-and-below units; terminals connecting to higher echelons.	Division-and-below Assumptions and Connectivity Diagrams
☐	Analyze capacity limitations of satellite terminals and other equipment based on network design and resource limitations (e.g., satellites).	Division-and-below Assumptions
☐	Analyze connectivity for all other division-and-below ESB and organic equipment. Note: Connectivity assessments for lower echelons may not be required because 1) the dynamic nature at lower echelons requires modeling and simulation, or 2) the echelon-focus of the scenario does not require an assessment.	Connectivity Diagrams
☐	Identify any force-pooled communications and network equipment, such as unmanned aircraft systems (UASs) and terrestrial relays, which require allocation across the force. Distribute the assets based on the scenario mission(s). Document their use and locations.	Division-and-below Assumptions, Equipment by Task Organization, and Locations of Systems
☐	Analyze and describe friendly force and host nation EMI effects on the force.	Division-and-below Assumptions
☐	Analyze threat network attacks and describe the effects on the force.	Division-and-below Assumptions
	After the scenario conference	
☐	Establish brigade-and-below subnet structures (command, intelligence, and fires nets) with radio channel designations.	Frequency Plan
☐	Put priorities on message and information types for transport across various types of communications equipment and layers (terrestrial, aerial, space).	Priority of Use List
☐	Complete the list of Division-and-below Assumptions.	Development Principles
☐	Summarize step 3 in a short capabilities description of the network.	Capabilities Description

Appendix D – Tool Examples

Purpose. This appendix presents two of the tools described in chapter 4. Table D-1 provides the Warfighter Information Network – Tactical (WIN-T) burst rate calculator format. A revised estimator should be created based on reviews of current technologies and developmental information. The spreadsheet for on-the-move (OTM) satellite access estimates is also provided (table D-2) for future use.

Table D-1. WIN-T Burst Rate Calculator Format.

User Input: Distance	Formula: Yields user throughput (in Kbps) per time slot (based on burst rate)	User Input: Number of time slots assigned per link	Formula: Total throughput (in bps)
2	417	12	5,004,000
2	417	9	3,753,000
2	417	2	834,000
2	417	12	5,004,000
5	280	9	2,520,000
5	280	6	1,680,000
5	280	12	3,360,000
5	280	9	2,520,000
16	133	6	798,000
16	133	9	1,197,000
16	133	9	1,197,000
16	133	2	266,000
22	86	2	172,000
22	86	9	774,000
22	86	6	516,000
22	86	2	172,000
30	43	9	387,000
30	43	2	86,000
30	43	12	516,000
30	43	9	387,000
33	0	6	-
Total time slots used		154	

Example maximum Time slot Allocation:		
	TCN	POP
Division	12	2
Brigade	9	2
Battalion	6	2

Assumptions:
1. All radios are JC4ISR running Increment 2 HNW or HNR running Increment 2 HNW software in 2016.
2. Each radio limited to 72 total time slots.
3. Frequency Reuse = 2 (Maximum time slots within the network = 160).
4. Time slots allocated as a function of NetOps.
5. Maximum range of HNR is 32.3 KM. Anything beyond that distance will not work (Yields 0 throughput).
6. Time slot and Burst Rate information will change with the Increment 3 HNW software for 2020 analysis.

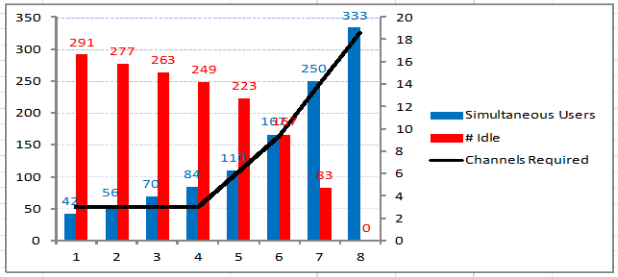
Table D-2. OTM Satellite Access Estimates.

Appendix D Annex II OTM Satellite Access Estimator.

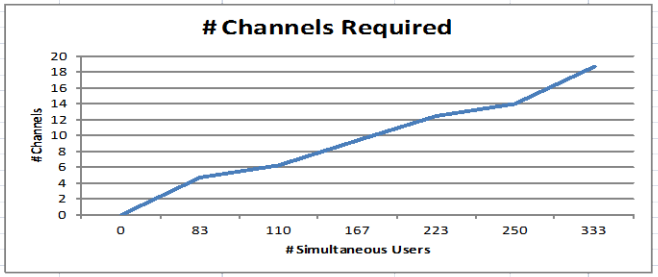
Channels Available to IX Corps	3
# SNE Access Per Channel	28
# POP Access Per Channel	14
# SNE in IX Corps	144
# POP in IX Corps	189
% SNE	43%
% POP	57%

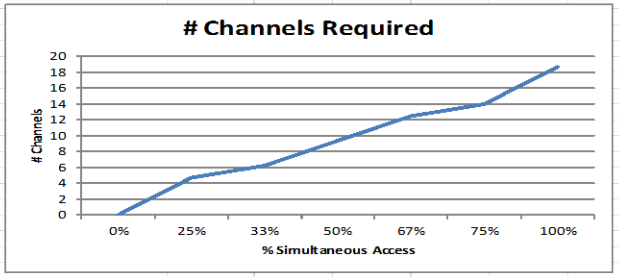
	SNE Channel	POP Channel	Total Channels	# SNE	# POP	# Simultaneous Users	% Access	Idle SNE	Idle POP	Total Idle	% Idle
Case 1	0	3	3			42	13%	144	147	291	87%
Case 2	1	2	3			56	17%	116	161	277	83%
Case 3	2	1	3			70	21%	88	175	263	79%
Case 4	3	0	3			84	25%	60	189	249	75%
Case 5	1.7	4.5	6.2	48	62	110	33%	96.48	126.63	223.11	67%
Case 6	2.6	6.8	9.3	72	95	167	50%	72	94.5	166.5	50%
Case 7	3.9	10.1	14.0	108	142	250	75%	36	47.25	83.25	25%
Case 8	5.1	13.5	18.6	144	189	333	100%	0	0	0	0%

	Channels Required	Simultaneous Users	# Idle
Case 1	3	42	291
Case 2	3	56	277
Case 3	3	70	263
Case 4	3	84	249
Case 5	6	110	223
Case 6	9	167	167
Case 7	14	250	83
Case 8	19	333	0



	# Channels	Users	% Access	% Idle
	0	0	0%	100%
	4.7	83	25%	75%
	6.2	110	33%	67%
	9.3	167	50%	50%
	12.5	223	67%	33%
	14.0	250	75%	25%
	18.6	333	100%	0%





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Appendix F – Glossary

ABCAS	Architecture Based Capabilities Assessment Software
ADA	air defense artillery
ADCON	administrative control
AFSB	army field support brigade
AH	attack helicopter
AIMD	Architecture Integration and Management Directorate
AKO	Army Knowledge Online
AM	amplitude modulation
AN	Army nomenclature (as in AN/PRC)
AO	area of operations
AoA	analysis of alternatives
AOR	area of responsibility
APC	Army processing center
APOD	aerial ports of debarkation
APS	Army pre-positioned stocks
ARCIC	Army Capabilities Integration Center
ARFOR	Army forces
ARFORGEN	Army force generation
ARNG	Army National Guard
ARS	armed reconnaissance squadron
ARSTRUC	Army structure
ASB	aviation support battalion
ASG	area support group
AST	ARFORGEN Synchronization Tool
AT	antitank
ATH	at-the-halt
AUS	Australia
AVCOM	aviation command
AVN	aviation
AWARS	Advanced Warfighting Simulation
BCT	brigade combat team
BDE	brigade
BfSB	battlefield surveillance brigade
BLOS	beyond line of site
BN	battalion
BOIP	basis of issue plan
bps	bits per second
BSB	brigade support battalion

BSC	brigade support center
BSTB	brigade special troops battalion
BTRY	battery
CA	civil affairs
CAB	combat aviation brigade
CADIE	Capabilities Assessment Development and Integration Environment
CAV	cavalry
CBA	capabilities-based assessment
CBT	combat
C-day	commencement day, the day on which a deployment operation commences or is to commence
CDB	Concepts and Doctrine Branch
CDID	Capability Development and Integration Directorate
CDR	commander
CERDEC	Communications-Electronics Research, Development, and Engineering Center
CHAP	chaplain
CHEM	chemical
CI	counter intelligence
CID	criminal investigation detachment or division
CIO	chief information officer or office
CJCMOTF	Combined Joint Civil-Military Operations Task Force
CJCSM	Chairman of the Joint Chiefs of Staff Manual
CJFACC	Combined Joint Forces Air Component Command
CJFLCC	Coalition Joint Forces Land Component Command
CJFMCC	Commander, Joint Forces Marine Component Command
CJFSOCC	Combined Joint Force Special Operations Component Command
CJPOTF	Combined Joint Psychological Operations Task Force
CJSOAC	Combined Joint Special Operations Air Component
CJSOTF	Combined Joint Special Operations Task Force
CJSOTF-E	Combined Joint Special Operations Task Force – East
CJSOTF-N	Combined Joint Special Operations Task Force – North
CJSOTF-S	Combined Joint Special Operations Task Force – South
CJTF	combined joint task force
CM	chemical
CMD	command
CO	company
COA	course of action
COCOM	Combatant Command
COE	center of excellence
COMBAT XXI	Combined Arms Analysis Tool for the 21st Century

COMPO	component
COMPO-1	Component 1, the Active Army
COMPO-2	Component 2, the Army National Guard
COMPO-3	Component 3, the United States Army Reserve
COMPO-4	Component 4, unresourced unit equivalents
CONOPS	concept of the operations
COTS	commercial off the shelf
CP	command post
CPP	command post platform
CRDD	Concepts, Requirements and Doctrine Division
CS	combat support
CSAR	combat search and rescue
CSB	combat support battalion
CSSB	combat services support battalion (Australian military)
DA	Department of the Army
D-day	the day on which a particular operation commences or is to commence
DEF	defense
DET	detachment
DIV	division
DOD	Department of Defense
DOT	Directorate of Training
DOTLMPF	doctrine, organization, training, materiel, leadership and education, personnel, and facilities
EIBCT	enhanced infantry brigade combat team
EIBCT	early IBCT
EMI	electromagnetic interference
EMP	electromagnetic pulse
EN	engineer
ENCOM	Engineer Command
ENG	engineer
EOD	explosive ordnance disposal
EPLRS	Enhanced Position Location Reporting System
ESB	expeditionary signal battalion
ESC	expeditionary signal command, expeditionary signal company
FA	field artillery
FDC	fire direction center
FDD	Force Design Directorate
FDO	fire direction officer
FFRDC	federally funded research and development center
FM	field manual, force management, frequency modulation
FORSCOM	United States Army Forces Command

FSB	forward support battalion
FSC	forward support company
FSE	fire support element
FY	fiscal year
GCC	Ground Component Command
G-day	the date of the order to deploy
GMD	ground-based midcourse defense
GNE	Global Network Enterprise
GOTS	government off-the-shelf
GRP	group
GS	general support
GSAB	general support aviation battalion
HBCT	heavy brigade combat team
HC3	high capacity communications capability
HHB	headquarters and headquarters battery
HHC	headquarters and headquarters company
HIMARS	High Mobility Artillery Rocket System
HMMWV	high- mobility multipurpose wheeled vehicle
HNR	high-band network radio
HNW	high-band networking waveform
HQ	headquarters
HQDA	Headquarters, Department of the Army
HUMINT	human intelligence
HyPR	Hybrid Pseudo-Random [dynamic scenario generation]
IBCT	infantry brigade combat team
ICW	in conjunction with
I-day	implementation day, the day intelligence indicators are recognized leading to operational plan (OPLAN) initiation
IER	information exchange requirement
IEWS	Integrated Electronic Warfare System
IL	Illinois
IN	infantry
INC	increment
INTELSAT	Intelligent Satellite Communications Solutions
IO	information operations
IOC	initial operational capability
IP	internet protocol
JC4ISR	joint command, control, communications, computers, intelligence, surveillance, and reconnaissance
JCA	joint capability area
JGN	joint gateway node

JIIM	joint, interagency, intergovernmental, and multinational
JNAT	Joint Network Analysis Tool
JNMS	Joint Network Management System
JOPES	Joint Operation Planning and Execution System
JTF	joint task force
JTRS	Joint Tactical Radio System
Kbps	kilobits per second
km	kilometer
LAD	latest arrival date
LCIT	Leader College of Information Technology
LGL	legal
LIN	line item number
LNO	liaison officer
LOS	line-of-sight
M	mechanized (usually following a unit designation)
M&S	models and simulations
MAC	mobility augmentation company
MBITR	multiband inter/intra team radio
Mbps	megabits per second
MCG	mobile command group
MCN-B	Main Communications Node - Basic
MCN-TS	Main Communications Node - Top Secret [tunneling capable]
MCO	major combat operation
MDMP	military decision making process
MDSC	Medical Deployment Support Command
ME (CSB)	maneuver enhancement (corps support brigade)
MEB	maneuver enhancement brigade
MED	medical
METT-TC	mission, enemy, terrain and weather, troops and support available, time available, and civil considerations
MF	multifunction
MHist	military history
MI	military intelligence
MIL	military
MISO	military information support operations
MLRS	Multiple Launch Rocket System
MLS	Multi-level Scenario
MOA	memorandum of agreement
MOB	mobile
MOU	memorandum of understanding
MP	military police

MRB	Materiel Requirements Branch
MRB	multi-role bridge
MTATS	Mission Thread Analysis Tool Suite
MTOE	modified table of organization and equipment
MVR	maneuver
MVTC	mobile virtual training capability
NAIS	Network Architecture Integration Service
NCA	narrow coverage area, National Command Authority
NCW	network-centric waveform
NETOPS or NetOps	network operations
NETWARS	Net Warfare Simulation
NOSC	Network Operations and Security Center
NS	network and services
NSC	National Support Center, Network Service Center
NSC-T	Network Service Center for Training
NT CBA	Network Transport Capabilities Based Assessment
OD or ORD	ordnance
OEMTD	Ordnance Electronic Maintenance Training Department
OFF	officer
OneSAF	One Semi Automated Force
OPCON	operational control
OPLAN	operational plan
OPNET	Optimized Network Evaluation Tool
OPORD	operations order
OPS	operations
OTM	on-the-move
OTOE	objective table of organization and equipment
PA	public affairs
PCD	personal communications device
PEO	program executive office
PH	phase
PLT	platoon
PM	project manager
POL	petroleum, oils, and lubricants
POM	Program Objective Memorandum
POP	point of presence
POR	program of record
PRC	portable radio communications
PSYOP	psychological operations (to be transitioned to *military information support operations (MISO)*)
QM	quartermaster

QT	quad-band terminal
QT-LA	quad-band terminal-large aperture
R&S	reconnaissance and surveillance
RAR	Royal Australian Regiment
RDEC	research and development centers
RECON	reconnaissance
REG	regiment
RETRANS	retransmission (communications)
RHN	regional hub node
Rngr	ranger
RSG	rear support group
RSOI	reception, staging, onward- movement and integration
RSTA	reconnaissance, surveillance, and target acquisition
SATCOM	satellite communications
SB	supply bulletin
SBCT	Stryker brigade combat team
SEAL	sea, air, land
SEC	section
SECTY	security
SF	special forces
SIG	signal
SIGCOE	United States Army Signal Center of Excellence
SINCGARS	Single Channel Ground and Airborne Radio System
SITS	Scenario Integration Tool Suite
SLAMRAAM	surface launched advanced medium range air to air missile
SMDC	Space and Missile Defense Command
SMK	smoke
SNE	soldier network extension
SOF	special operations forces
SP	self-propelled
SPEED	Systems Planning Engineering and Evaluation Device
SPOD	sea ports of debarkation
SPT	support
SQDN	squadron
SRC	standard requirements code or special requirements code
STB	special troops battalion
STEP	standard tactical entry points
STT	satellite tactical terminal
SVC	services
TAA	Total Army Analysis
TAB	target acquisition battery

TAC	tactical command post
TACON	tactical control
TASB	theater aviation support brigade
TASM-G	tactical air support module - ground
TAVN	theater aviation
TCF	tactical combat force
TCM	Training and Doctrine Command (TRADOC) Capability Manager
TCM GNE	Training and Doctrine Command Capability Manager Global Network Enterprise
TCM NS	Training and Doctrine Command Capability Manager Networks and Services
TCM TR	Training and Doctrine Command Capability Manager Tactical Radio
TCN	tactical communications node
TDRM	Transport Design Reference Model
TIB	theater intelligence brigade
TISC	Theater Information Support Command
TM	team
TNOSC	Theater Network Operations and Security Center
TOE	table of organization and equipment
TR	tactical radio, tactical relay
TRAC	Training and Doctrine Command Analysis Center
TRADOC	Training and Doctrine Command
TRISA	TRADOC Intelligence Support Activity
TRP	troop
TR-T	tactical relay tower
TV	television
UAS	unmanned aerial or aircraft system
UAV	unmanned aerial vehicle
UH	utility helicopter
USAFMSA	U.S. Army Force Management Support Agency
USAR	United States Army Reserve
VRC	vehicular radio communications
VWP	vehicle wireless package
WGS	Wideband Global SATCOM
WHL	wheeled
WIN-T	Warfighter Information Network - Tactical
WMSL	weapons, munitions, and sensors list